TYM

WORKSHOP MANUAL

FOR

TRACTORS

(T303HST/T353HST)

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BYUCKSAN GROUP
TONGYANG MOOLSAN CO., LTD.

#604-9, Namsan-dong, Changwon-city, Kyungnam, Korea ■TEL:82-55-279-4379, FAX:82-55-279-4447■www.tym.co.kr

HST TRACTOR

T303HST/T353HST

WORKSHOP MANUAL

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Chapter 1
Introduction

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Chapter 1 .Introduction

This tractor Workshop manual is for qualified service personnel engaged in servicing and overhauling T303HST/T353HST tractor.Use of this publication is not recommended for field operators since they usually do not have access to special tools and shop equipment essential for most servicing.

Servicing procedures outlined herein contain sufficient information to return all component parts of a tractor to new condition. In discussion of each component parts,it is assumed that a complete overhaul is been performed,consequently,

complete disassembly and reassembly are outlined.The mechanic is relied upon to decide how far disassembly must be carried when complete overhaul is not required.

Study unfamiliar service procedures thoroughly and clearly understood before attempting disassembly. Specific data essential for proper overhaul,such as running clearances and torque values,have been provided in interline of Inspection and reassembly procedures of each group section.

This manual was compiled from latest information available at time of publication.

Manufacturer reserves the right to make changes at any time without notice.

Whenever the terms "left"and "right" are used, They means as viewed by the operator when seated in the operator's seat.

SAFETY INSTRUCTION

ALWAYS PRACTICE SAFETY BY THINKING BEFORE ACTION

AVOID FIRE HAZARDS.

-Keep fire extinguishers easily available and in good operating condition.
All relevant personnel should know how to operate fire fighting equipment.

-Keep a first aid kit in an easily accessible location.

-Do not smoke while handling fuel,or other highly flammable material.

-Do not use an open pail for transporting fuel.

-Use of an approved fuel container.

-Dispose of all fuel-soaked rags in covered containers where cigarettes cannot be dropped carelessly.

-Do not smoke and avoid open flame when charging,jumping,or boosting batteries.

-Batteries give off gas which is flammable and explosive.

-Do not charge batteries in a closed area. Provide proper ventilation to avoid explosion of accumulated gases.

Avoid acid burns.

-Wear safety goggles when handling battery electrolyte.It contains sulfuric acid which is a poison and can cause blindness.Avoid it contacting eyes,skin,or clothing. sulfuric acid will eat through clothing and can cause severe burns to skin.

AVOID HIGH-PRESSURE FLUIDS

1) Before beginning work on hydraulic system components,turn off engine and operate hydraulic control levers to relieve internal hydraulic pressure.

2) Oil under pressure can penetrate skin and lead to personal injury.Treat sources of oil pressure with extreme care,wearing safety goggles.

3) If hydraulic leak develops,correct immediately.Escaping hydraulic oil can have extremely high pressure. A stream of high pressure oil may easily penetrate skin just like modern needless vaccination equipment,but with the exception that hydraulic fluid may cause blood poisoning. It is imperative that connections are tight and that all lines and pipes should be in good condition. If injured by escaping hydraulic fluid,see a doctor at once.

STAY CLEAR OF PTO

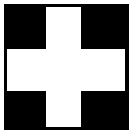
1) Entanglement in rotating drive line can cause serious injury or death.
2) Keep tractor master shield and drive line shield in place at all times except for special applications as directed in the implement operator's manual.
3) Wear fairly tight tight fitting clothing.Stop the engine and be sure PTO driveline is stopped before making adjustment,connections,or cleaning out PTO drive equipment.

SERVICE TIRES SAFELY

-Tire changing can be dangerous and should be done by trained personnel using proper tools and equipment.
-Do not re-inflate a tire that has been run flat or seriously under-inflated.Have it checked by qualified personnel.
-Use wheel handling equipment adequate for weight involved when removing and installing wheels.

WARNING SIGNS IN THIS MANUAL

The following warning symbols in this manual draw additional attention to items of importance for the safe and correct operation of the tractor.

SIGN	MEANING OF SIGN
DANGER	**Serious hazard with a very high level of risk of either serious injury or death**
WARNING	**Hazard or unsafe practice that can lead to severe injury or death.**
CAUTION	**Hazard or unsafe practice that can lead in injury or death.**
 **IMPORTANT**	**Instructions for the correct operation of the machine which, if followed, will ensure that it performs at it's best**

SAFETY SIGNS

RECOGNIZE SAFETY INFORMATION

This symbol, Safety-Alert Symbol, means ATTENTION! YOUR SAFETY IS INVOLVED.

The message that follows the symbol contains important information about safety. Carefully read the message

SIGNAL WORDS.

A signal word—DANGER, WARNING OR CAUTION—is used with safety alert symbol. DANGER identifies the most serious hazards. Safety signs with signal Word —DANGER OR WARNING—are typically near specific hazards. General precautions are listed on CAUTION safety signs.

DANGER

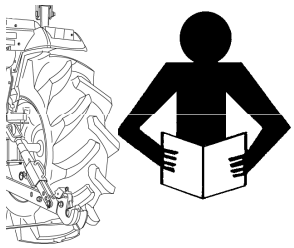
WARNING

CAUTION

READ SAFETY INSTRUCTION

Carefully read all safety instructions given in this manual for your safety. Tempering with any of the safety devices can cause serious injuries or death. Keep all safety signs in good condition. Replace missing or damaged safety signs.

Keep your tractor in proper condition and do not allow any unauthorized modifications to be carried out on the Tractor, which may impair the function/safety and affect Tractor life.



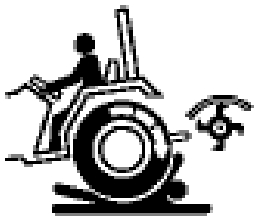
PROTECTION CHILDREN

Keep children and others away from the Tractor while operating.

BEFORE YOU REVERSE

- Look behind Tractor for children.

- Do not let children to ride on Tractor or any implement.



HANDLE FUEL SAFELY-AVOID FIRES

Handle fuel with care; it is highly flammable. Do not refuel the Tractor while smoking or near open flame or sparks.

Always stop engine before refueling Tractors.

Always keep your tractor clean of accumulated grease, and debris. Always clean up spilled fuel.

STAY CLEAR OF ROTATING SHAFTS

Entanglement in rotating shaft can cause serious injury or death.

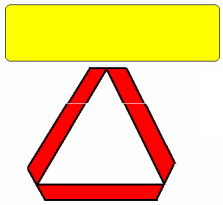
Keep PTO shield in place at all times.

Wear close fitting clothing. Stop the engine and be sure PTO drive is stopped before making adjustments, connections, or cleaning out PTO driven equipment.

ALWAYS USE SAFETY LIGHTS AND DEVICES

Use of hazard warning lights and turn signals are recommended when towing equipment on public roads unless prohibited by state or local regulations.

Use slow moving vehicle (SMV) sign when driving on public road during both day & night time, unless prohibited by law



PRACTICE SAFE MAINTENANCE

Understand service procedure before doing work.

Keep the surrounding area of the Tractor clean and dry.

Do not attempt to service Tractor when it is in motion.

Keep body and clothing away from rotating shafts.

Always lower equipment to the ground. Stop the engine.

Remove the key. Allow Tractor to cool before any work repair is caused on it.

Securely support any Tractor elements that must be raised for service work.

Keep all parts in good condition and properly installed.

Replace worn or broken parts. Replace damage/missing decals.

Remove any buildup of grease or oil from the Tractor.

Disconnect battery ground cable(−) before making adjustments on electrical systems or welding on Tractor

TRACTOR RUNAWAY

1.The tractor can start even if the transmission is engaged position causing Tractor to runaway and serious injury to the people standing nearby the tractor.

For additional safety keep the pull to stop knob (fuel shut off control) in fully pulled out position. Transmission in neutral position, Foot brake engaged and PTO lever in disengaged position while attending to Safety Starter Switch or any other work on Tractor.

SAFETY STARTER SWITCH

1. **Clutch operated safety switch is provided on all Tractors which allow the starting system to become operational only when the Clutch pedal is fully pressed.**
2. **Do not By-pass this safety starter switch or work on it. Only Authorized Dealers are recommended to work on safety starter switch.**
3. **On some models Safety Starter switch is provided on transmission High-low shifter lever and in PTO shifter lever.The tractor can be started only if High-low shifter lever is in neutral position.**

Safety Starter Switch is to be replaced after every 2000 hours/4 years, whichever is earlier

USE OF ROPS AND SEAT BELT

The Roll Over Protective Structure(ROPS) has been certified to industry and/or government standards. Any damage or alternation to the ROPS, mounting hard-ware, or seat belt voids the certification and will reduce or eliminate protection for the operator in the event of a roll-over. The ROPS, mounting hardware, and seat belt should be checked after the first 100 hours of Tractor and every 500 hours thereafter for any evidence of damage, wear or cracks. In the event of damage or alteration, the ROPS must be replaced prior to further operation of the Tractor.

The seat belt must be worn during machine operation when the machine is equipped with a certified ROPS.

Failure to do so will reduce or eliminate protection for the operator in the event of a roll over.

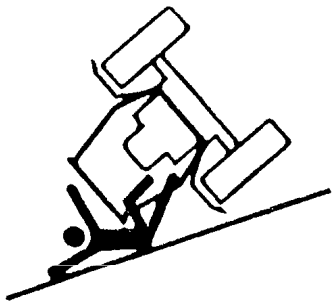
PRECAUTION TO AVOID TIPPING

Do not drive where the Tractor could slip or tip.

Stay alert for holes and rocks in the terrain, and other hidden hazards.

Slow down before you make a sharp turn.

Driving forward out of a ditch or mired condition could cause Tractor to tip over backward. Back out of these situations if possible

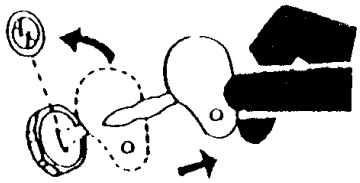


PARK TRACTOR SAFELY

Before working on the Tractor ;

Lower all equipment to the ground.

Stop the engine and remove the key



KEEP RIDERS OFF TRACTOR

Do not allow riders on the Tractor.

Riders on Tractor are subject to injury such as being stuck by foreign objects and being thrown off of the Tractor

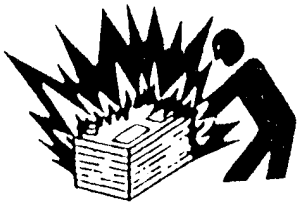
AVOID HIGH-PRESSURE FLUIDS

Escaping fluid under pressure can penetrate the skin causing serious injury. Keep hands and body away from pinholes and nozzles, which eject fluids under high pressure. If ANY fluid is injected into the skin. Consult your doctor immediately.

PREVENT BATTERY EXPLOSIONS

Keep sparks, lighted matches, and open flame away from the top of battery. Battery gas can explode.

Never check battery charge by placing a metal object across the poles.



PREVENT ACID BURNS

Sulfuric acid in battery electrolyte is poisonous. It is strong enough to burn skin, cause holes in clothing and cause blindness if found entry into eyes.

For adequate safety always;

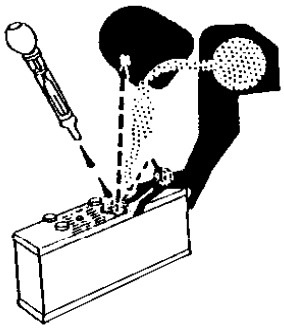
1. Fill batteries in a well-ventilated area.
2. Wear eye protection and acid proof hand gloves
3. Avoid breathing direct fumes when electrolyte is added.
4. Do not add water to electrolyte as it may splash off causing severe burns.

If you spill acid on yourself;

1.Flush your skin with water.

2.Flush your eyes with water for 10-15 minutes.

Get medical attention immediately.



SERVICE TRACTOR SAFELY

Do not wear a necktie, scarf or loose clothing when you work near moving parts. If these items were to get caught, severe injury could result.

Remove rings and other jeweler to prevent electrical shorts and entanglement in moving parts.

WORK IN VENTILATED AREA

Do not start the Tractor in an enclosed building unless the doors & windows are open for proper ventilation, as tractor fumes can cause sickness or death. If it is necessary to run an engine in an enclosed area remove the exhaust fumes by connecting exhaust pipe extension.

SAFETY DECALS

The following safety decals ARE INSTALLED ON THE MACHINE.

If a decal become damaged,illegible or is on the machine,replace it.The decal part number is listed in the parts lists.

WARNING

- Before starting and operating know the operating and safety instructions in the operators Manual and on the tractor.
- Clear the area of bystanders.
- Locate and know operation of controls.
- Start engine only from Operator's seat with depressed clutch pedal, transmission in the neutral, PTO disengaged and hydraulic control in lower position
- Slow down on turns, rough ground and slopes to avoid upset.
- Do not permit anyone but the operator to ride on the tractor. There is no safe place for rider.
- Lock brakes together, use warning lights and SMV emblem while driving on roads.
- Lower equipment, place gear shift levers in neutral, stop engine, remove the key and apply parking brake before leaving the tractor seat.
- Air pressures are specified by the manufacturer.

FAILURE TO FOLLOW ANY OF THE INSTRUCTIONS ABOVE CAN CAUSE SERIOUS INJURY TO THE OPERATOR.

Location: On FENDER LH

Part No.: 1260-904-070-1A

WARNING

TO AVOID POSSIBLE PERSONAL INJURY, THIS GUARD MUST BE KEPT IN PLACE

Location: ON PTO guard

Part No.: 1260-904-069-0A

CAUTION

TO PROTECT ENGINE AND HYDRAULIC COMPONENTS.

- Idle Engine for 1 minute before shut down or full load operation.
- **Do not exceed 1/2 throttle for first 5 minutes of operation**

Location: On Dash cover side RH

Part No.: 1260-904-064-0

WARNING

KEEP HANDS AND CLOTHING
AWAY FROM ROTATING FAN AND BELTS TO PREVENT
SERIOUS INJURY

Location: On Radiator bracket side LH & RH

Part No.: 1260-904-061-0

WARNING

The cooling system operates under pressure.

- **It is dangerous to remove the radiator cap while the system is hot.**
- **Always turn the cap slowly to the first stop and allow pressure to escape before removing the cap completely.**
- **When operating below 32°F, use suitable anti- freeze solution as coolant**

Location: On Radiator bracket side LH&RH

Part No.:1260-904-063-0

CAUTION

BEFORE OPERATE THE TRACTOR,READ THE OPERATOR'S MANUAL THOROUGHLY,TO UNDERSTAND THE IMPORTANT FUNCTIONS AND CONTROLS.

Location: On dash cover side LH

Part No.:1260-904-067-0A

WARNING

- **Pull only from drawbar. Pulling from any other point can cause rear overturn.**
- **Do not operate with unshielded PTO.**
- **Disengage PTO and stop engine before servicing tractor or attaching and detaching implements.**
- **When towing equipment use a Safety chain**

FAILURE TO FOLLOW ANY OF THE INSTRUCTIONS ABOVE CAN CAUSE SERIOUS INJURY TO THE OPERATOR OR OTHER PERSONS.

Location: On rear frame

Part No.: 1260-904-065-0A

DANGER

BLINDNESS CAN RESULT FROM BATTERY EXPLOSION.

KEEP SPARKS OR OPEN FRAMES AWAY FROM BATTERY.

DO NOT JUMP START.

BURNS CAN RESULT FROM BATTERY ACID.

IN CASE OF CONTACT FLUSH IMMEDIATELY WITH WATER

Location: On battery bracket RH

Part No.: 1260-904-066-0

WARNING

- Start engine only from operators seat. If safety start switch is bypassed engine can start with transmission in gear.
- Do not connect or short across terminal on starter solenoid.

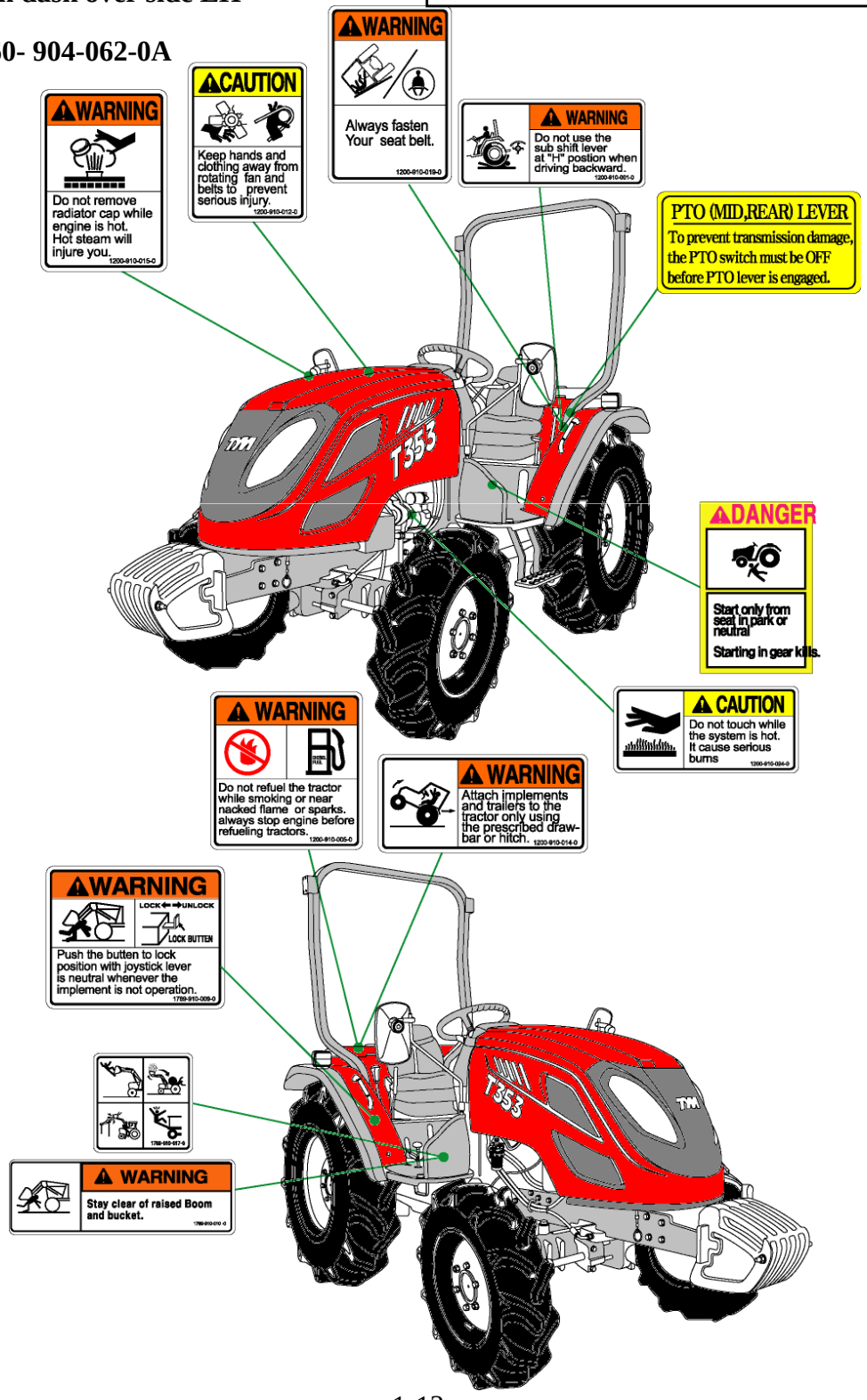
  Attach booster cables as shown on battery decal and operator's manual.

Starting in gear causing runaway can result in serious injury.

Location: On dash over side LH

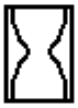
Part no: 1260- 904-062-0A

SAFETY SIGNS


WARNING
Always fasten Your seat belt.
WARNING
Do not use the sub shift lever at "H" postion when driving backward.
WARNING
Do not remove radiator cap while engine is hot. Hot steam will injure you.
CAUTION
Keep hands and clothing away from rotating fan and belts to prevent serious injury.
PTO (MID,REAR) LEVER
To prevent transmission damage, the PTO switch must be OFF before PTO lever is engaged.
DANGER
Start only from seat in park or neutral
Starting in gear kills.
CAUTION
Do not touch while the system is hot. It cause serious burns
WARNING
Do not refuel the tractor while smoking or near nacked flame or sparks. always stop engine before refueling tractors.
WARNING
Attach implements and trailers to the tractor only using the prescribed draw-bar or hitch.
WARNING
Push the butten to lock position with joystick lever is neutral whenever the implement is not operation.
WARNING
Stay clear of raised Boom and bucket.

UNIVERSAL SYMBOLS

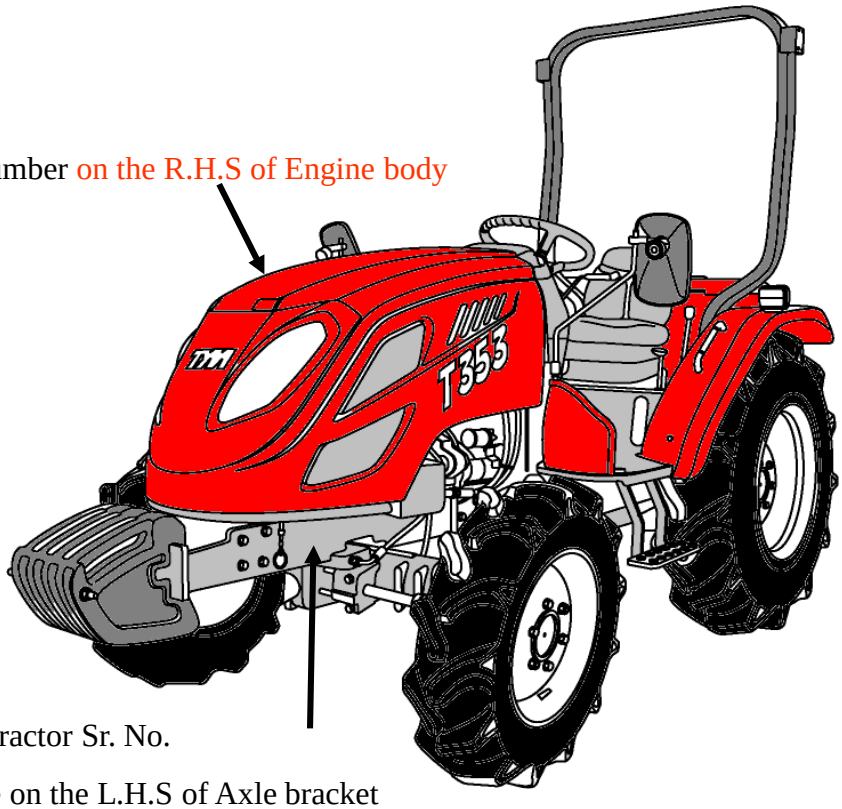
Some of the universal symbols have been shown below with an indication of their meaning

Engine speed rev/minX100)	**Pressured-open slowly**	**Corrosive substance**
 **Hours, recorded**	**Continuous variable**	**”Tortoise” Slow or minimum Setting**
Engine coolant temperature	**Warning**	**”Hare” fast or maximum setting**
Fuel level	**Hazard warning**	**Transmission oil pressure**
Engine Stop control	**Neutral**	**Turn signal**
Lights	**Fan**	**Transmission oil temperature**
Horn	**Power take off engaged**	**parking brake**
Engine oil pressure	**Power take off Disengaged**	**Work lamps**
Air filter	**Lift arm/raise**	**Differential lock**
Battery charge	**Lift arm/lower**	**See operator’s manual**

SECTION 1. TRACTOR TYPES AND PUNCHED IDENTIFICATION MARKS

The tractor serial number is shown on the left hand side of the tractor as shown in the picture.

The engine number is stamped on the top of the engine block.


Engine type and number on the R.H.S of Engine body
T353
Manufacturer's tractor Sr. No.
stamped on plate on the L.H.S of Axle bracket

1.MODEL NAME PLATE

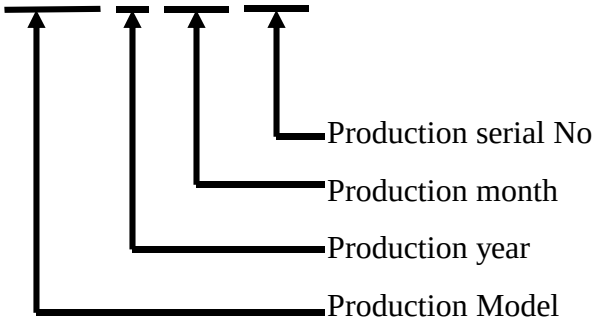
The plate indicates the model and type of the tractor.

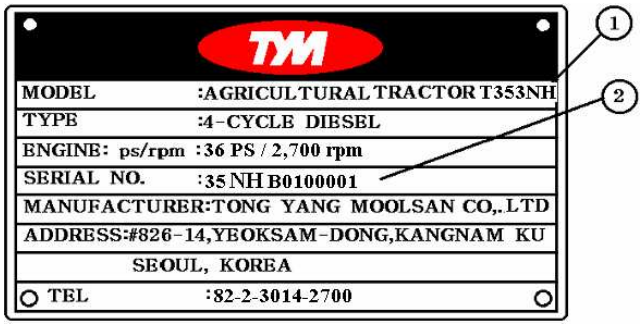
① Model name

② Production I.D No.

The production I.D reference number is as shown below

353NH B 01 00001





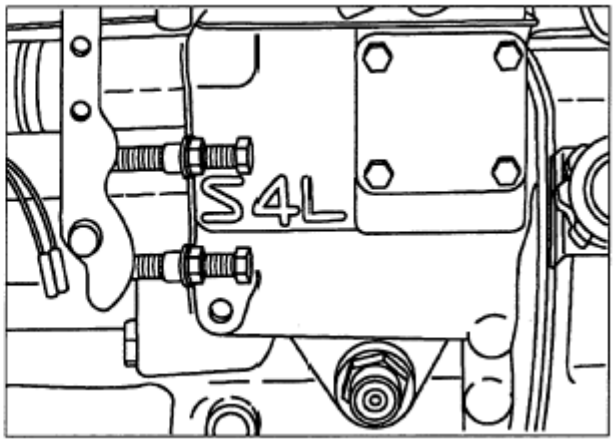
3.Engine model Identification and serial number Location.

1. Model identification location

(a) The model identification is embossed on the right side of the cylinder block, near the fuel injection pump mount.

(b) The model identifications and displacements of the engines in current production are as listed below:

	Displacement
S3L	1.125 liters (68.7 cu in.)
S3L2	1.318 liters (80.4 cu in.)
S4L	1.500 liters (91.5 cu in.)
S4L2	1.758 liters (107.3 cu in.)



Model identification location

(c) A scheme of coding used for identifying the engines in current production is as follows:

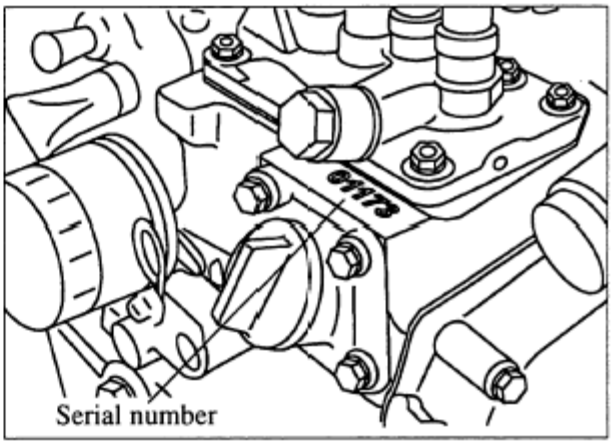
Example: Coded designation

S 4 L (2) – 61 A

- A — Specification code
- 1 — Export code
- (2) — Stroke code (No code: 78.5 mm (3.09 in.), 2: 92 mm (3.62 in.)
- L — Series code [Bore: 78 mm (3.07 in.)]
- 4 — Number-of-cylinders code ["4" stands for four cylinders]
- S — Identification of "Sagamihara Machinery Works"

2. Serial Number Location

The serial number is punched on the cylinder block, near the fuel injection pump mount.



Serial number location

SECTION 2. SPECIFICATIONS

MODEL		T303HST/T353HST
Engine	Maker	MITSUBISH
	Model	S4L / S4L2
	Type	Water cooled 4 cycle 4 cylinder diesel
	Out put (Kw/rpm)	T303HST - 21.9 / 2700rpm T353HST - 26.5 / 2700rpm
	Number of Cylinder	4
	Displacement (cm^3)	1500cm^3 / 1,758 cm^3
	Bore and Stroke	T303HST - 78 mm X 78.5mm T353HST - 78 mm X 92mm
	Compression ratio	T303SHT - 21.3±0.5 T353HST - 24.3±0.5
	Firing order	1-3-4-2
	Injection pump	Direct
	Lubrication type	Forced circulation
	Cooling system	Water cooled, Forced circulation
	Coolant capacity	7ℓ(1.85 US gal)
	Air cleaner	Dry Single Element
	Muffler	Horizontal
	Fuel	Diesel fuel
	Fuel Tank capacity	33ℓ(8.7 US gal)
Electrical	Battery	12V80AH
	Starting system	Starter motor with pre-heater
	Starter Capacity	2.0KW
Drive Train	Alternator	12V 50A
	Transmission	Hydraulic, + Mechanical 3 range gear with constant-mesh
	MFWD(4WD)	Standard
	Differential lock	Bevel gears with diff-Lock
	Brakes	Wet disc brake, mechanical
	Steering	hydraulic

MODEL			T303HST/T353HST
Clutch	Main		Dry single disc, mechanic
	PTO		Multiple wet disk
Dimensions	Overall length(mm)		3337 (131.4”)
	Overall width (mm)		1635 (64.37”)
	Overall Height (mm)		2400 (94.49”)
	Wheel base (mm) (Distance between shafts)		1100 (43.31”)
	Min. Ground Clearance (mm)		323 (12.72”)
	R1	Front	7-16, 4PR
		Rear	11.2-24, 8PR
	R1	Front	8-16, 4PR
		Rear	12.4-24, 6PR
	R4	Front	27X10, 50-15, 8PR
		Rear	12.5-20 R4, 12PR
	R3	Front	27X10, 50LL-15, 6PR
		Rear	41X14, 00-20- RL
	Axle type	Front	Center pin
		Rear	Central axle

Implement	Operation	Hydraulic
	Mounting method	3-Point hitch
	Drawing method	Trailer hitch
	3-Point hitch category	Category 1
	Hydraulic-control	Position, Remote control, Joystick

Traveling speeds:Km/h (Mile/h)

Range shift	Engine rpm @2,700	
	Forward	Reverse
L	~6.2 (~3.85)	~6.2 (~3.85)
M	~11.5 (~7.14)	~11.5(~7.14)
H	~25 (~15.54)	~25(~15.54)

MEMO

SECTION 3. GEAR TRAIN DIAGRAMS

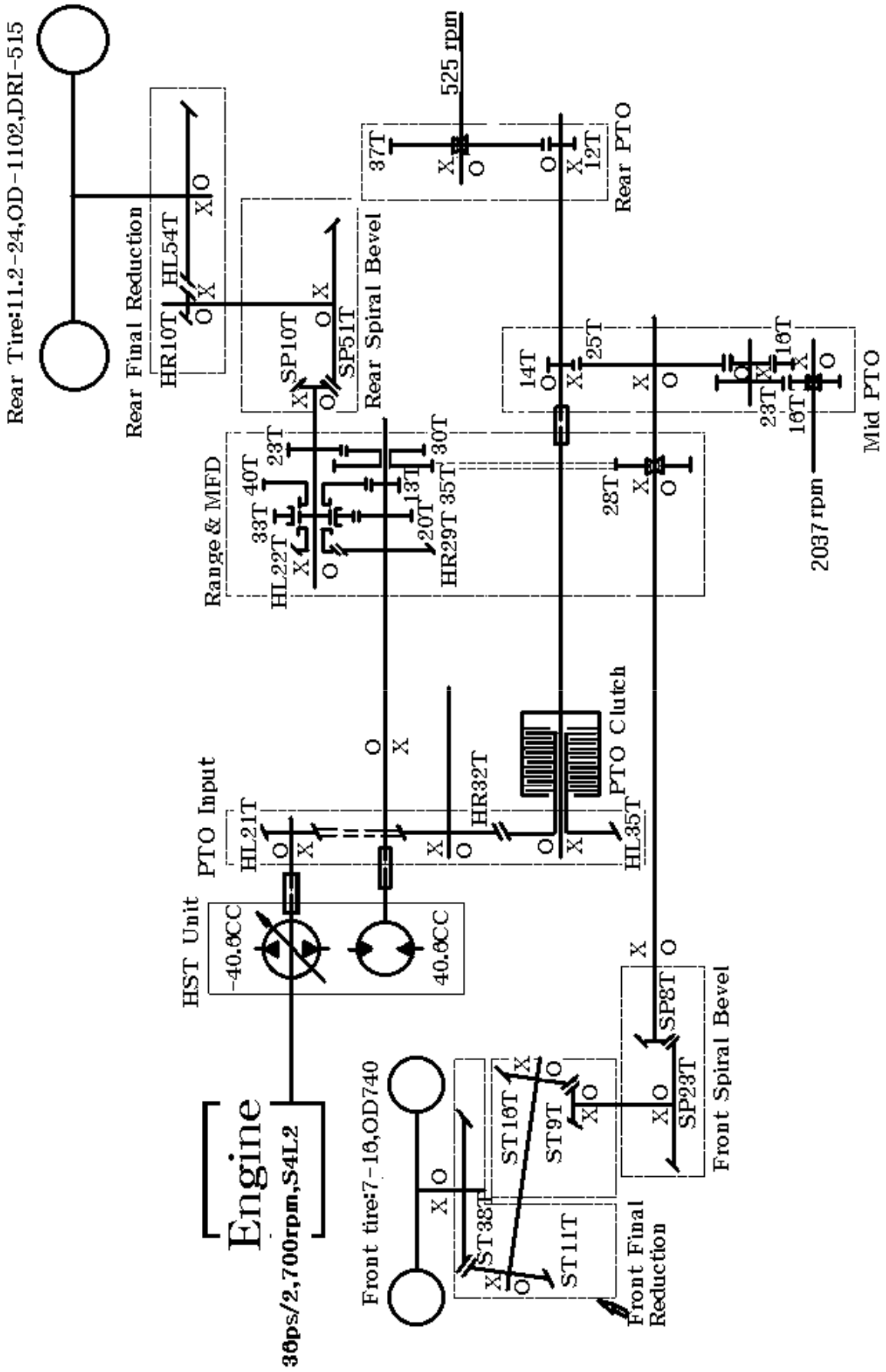
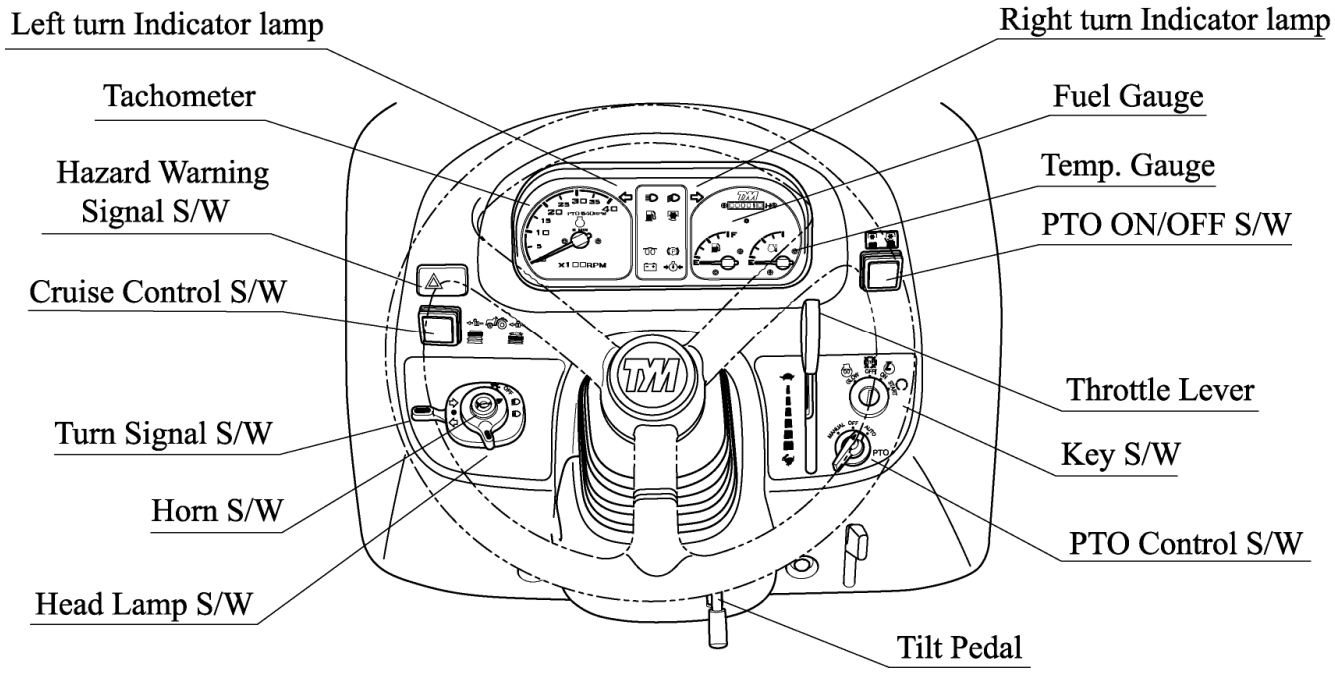


FIG.1-3 GEAR TRAIN DIAGRAM

SECTION 4. PRECAUTION FOR TRACTOR OPERATION

1. INSTRUMENTS



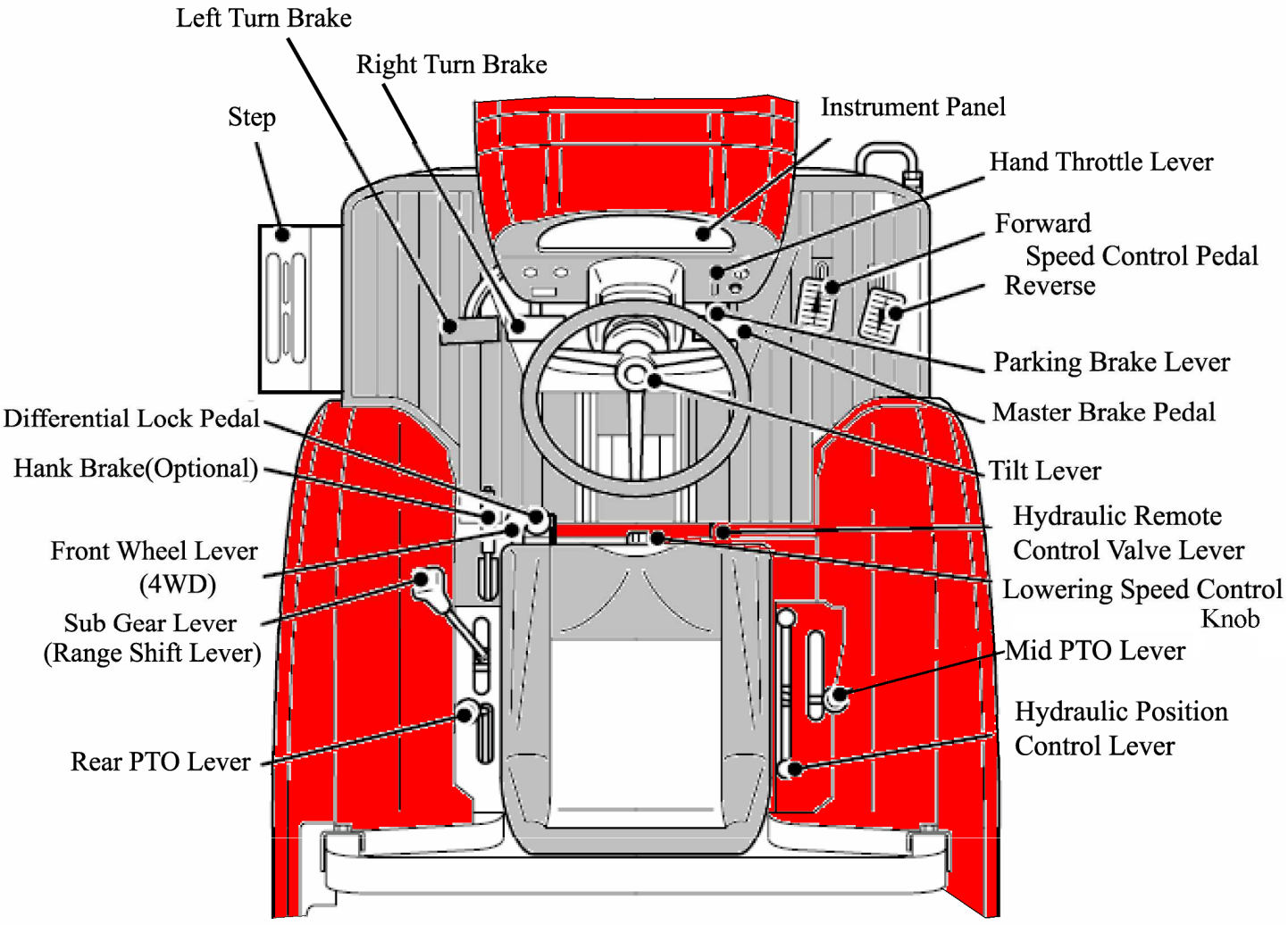
Note;

Oil pressure warning light and charge light on the monitor array will light when the main switch is turned from OFF to ON

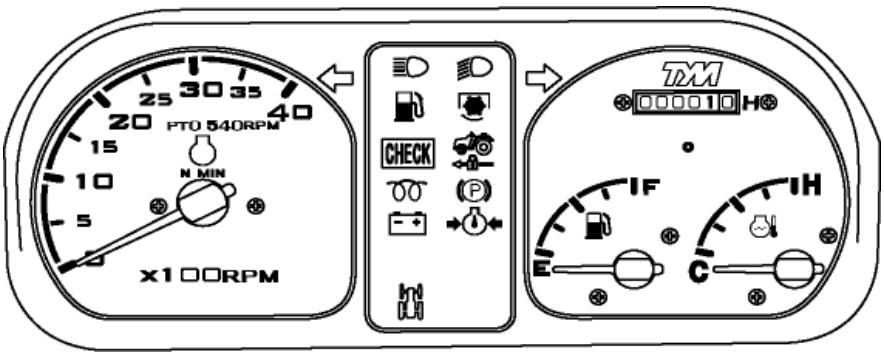
- All lights on the panel go out automatically when the engine is started and its speed is increased to a specific level.
- Do not panic if some lights on the monitor light array do not go out while the engine is at idle speed just after its starting.They will go out automatically when the engine speed reaches as a specific level.

MEMO

2.CONTROLS



MONITOR LIGHT ARRAY



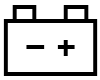
High beam lamp

Low beam lamp

PTO monitor Lamp

fuel

4WD drive lamp



Charge lamp

Glow signal Lamp

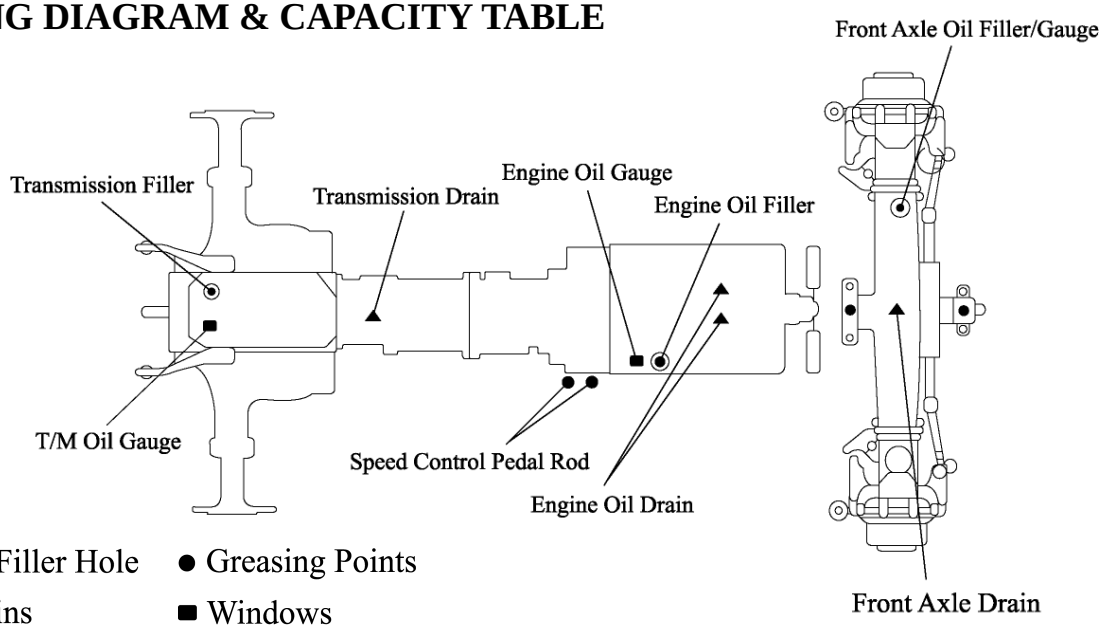
Oil pressure lamp

Parking brake lamp

Check lamp

Cruise Control Lamp

3. FILLING DIAGRAM & CAPACITY TABLE



⦿ Oil Filler Hole ● Greasing Points

▲ Drains ■ Windows

TABLE 1-7

No.	Filling point	Fillings	Quantity Liter (gal.)
	MODEL		T303HST/T353HST
1	RADIATOR	50/50 : Ethylene Glycol/Water (L.L.C) ASTM D4985 / D6210	7ℓ(1.85 US gal)
2	ENGINE	API : CF-4 grades Above:25°C(77°F)… SAE30 or 15W/40 0°C to 25°C(32°F to 77°F)… SAE20 or 10W30 Below 0°C(32°F)… SAE 10W or 10W-30	5 ℓ (1.32 US gal)
3	TRANSMISSION CASE	See next page *	35ℓ(9.25 US gal)
4	FRONT AXLE	Gear oil #80 or #90 (API GL-4 grade)	8.2ℓ(2.166US gal)
5	FINAL DRIVE CASE(B)	Gear oil #80 or #90 (API GL-4 grade)	
6	Clutch pedal shaft	Grease	As required
7	BALL JOINT	Grease	As required
8	FUEL TANK	Diesel fuel	33ℓ(8.717 US gal)

Tire size and inflation

TABLE 1-8

Tire	DIVISION	SIZE	Air pressure Mpa (PSI)	MODEL
R1 (Ag)	Front	7-16, 4PR	0.176 Mpa (25.53 PSI)	T303HST T353HST
	Rear	11.2-24, 8PR	0.235 Mpa (34.08 PSI)	
R1 (Ag)	Front	8-16, 4PR	0.176 Mpa (25.53 PSI)	
	Rear	12.4-24, 6PR	0.176 Mpa (25.53 PSI)	
R4 (Ind)	Front	27X10, 50-15, 8PR	0.380 Mpa (55.11 PSI)	
	Rear	12.5-20 R4, 12PR	0.340 Mpa (49.31 PSI)	
R3 (Turf)	Front	27X10, 50LL-15, 6PR	0.220 Mpa (31.91 PSI)	
	Rear	41X14, 00-20- RL	0.170 Mpa (24.66 PSI)	

4. MAINTENANCE CHART

○ inspection,replenish,and adjustment

● Replacement △ Cleaning and/or washing

☞ **ENGINE**

★ Consult your Dealer

Inspection items	Daily	Inspection and servicing intervals Hour of operation (X10 on hour meter)												Intervals after that	Judgment criteria mm(in)
		5	10	15	20	25	30	35	40	45	50	55	60		
Engine oil	○	●		●		●		●		●		●		Replace after every 100hours	Level is between upper and lower limits
Oil filter		●				●				●					
Air cleaner			△		△		△		△		△		●	Clean after every 100hrs.Replace element that has been washed more than 5 times	
Radiator coolant	○													Replace every year	Fill coolant up to radiator throat
Radiator	○														
Radiator fin & screen	○				△				△				△		Clean cooling fins and cores
Fuel	○													Everyday and before work	Tank should be full
Fuel filter	○	△	○	△	○	△	●	○	○	△	○	△	●	Wash after every 100hrs.and replace after 300 hrs.	
Fan belt	○														About 5(0.20in) deflection pushed with a finger
Hose clamps	○														
Electrolyte level	○		○		○		○		○		○		○	Check after every 100hrs.and replenish if necessary	

○ inspection,replenish,and adjustment

● Replacement △ Cleaning and/or washing

★ Consult your Dealer

☞ TRANSMISSION

Inspection items	Daily	Inspection and servicing intervals Hour of operation (X10 on hour meter)												Intervals after that	Judgeement criteria mm(in)
		5	10	15	20	25	30	35	40	45	50	55	60		
Transmission oil	○	●						●						Replace after initial 50 hrs,then after every 300 hrs.	Clean hydraulic suction filter at the same time.
Strainer		△						△							
HST oil		●						●							
Front axle oil		●		○		○		○		○		○	○	Check after every 100 hrs.Replace after every 600hrs.	
Brake pedal	○														Free play: 1.18~1.57 in
Greasing up each part	○													Replenish after every 50 hrs(every time after pudding)	
Steering wheel free play	○														
Toe-in							★						★	Check every 300 hrs	0.08~0.24 in
Front wheel hub greasing														Inject grease after every 900 hrs	
Retightening ball joints of steering system	○													Check after every 300 hrs	
Wheel tightening bolts	○														All should be tighten
Greasing each nipple		○	○	○	○	○	○	○	○	○	○	○	○	Replenish every 50 hrs (Everyday in dusty condition)	
Loose bolts and nuts	○														
Electric wiring	○			○			○							Check every year	

Inspection items	Daily	Inspection and servicing intervals Hour of operation (X10 on hour meter)												Intervals after that	Judgment criteria mm(in)
		5	10	15	20	25	30	35	40	45	50	55	60		
Electric Parentheses															All should work properly
Adjusting accelerator pedal and throttle lever								★					★	Check after 300 hours	
Oil leaks in clutch housing														Check every year by removing the plug installed in the front bottom of clutch chamber	
Hydraulic fluid filter		●							●					Replace after initial 100 hrs.and then after every 300 hrs	
4WD front axle housing oil			●		○		○		○		○		○	Check after every 100 hrs.Replace after every 600hrs	
Rubber pipes				○		○		○		○			○	Check after every 100 hrs.	

1) Every terminal should be connected securely

2) Wiring should not interfere with other parts.

3) Fatigued wiring should be replaced.

4) Wiring should be held in each clamp properly.

Chapter 2
Disassembly and reassembly of major components

SECTION 1. GENERAL PRECAUTIONS AND SEPARATION AND REINSTALLATION ---------- 2-1

1. Before operation ---------- 2-1

2. Precautions to be followed when installing standardized parts. ---------- 2-1

SECTION 2. OPERATION CHART FOR DISASSEMBLY AND REASSEMBLY BY MAJOR BLOCKS---------- 2-4

SECTION 3. SEPARATION OF MAJOR COMPONENTS -------- 2-5

1. Separation of the front axle and axle bracket ---------- 2-5

2. Separation of the engine and front axle bracket ---------- 2-6

3. Separation of the engine and front transmission ---------- 2-7

4. Separation of the front transmission and mid transmission---------- 2-12

5. Separation of the mid transmission and rear trans mission---------- 2-16

6. Separation of the rear transmission and rear axle housing ---------- 2-18

7. Separation of the rear transmission and MID PTO ---------- 2-20

8. Separation of the rear transmission and Cylinder case ---------- 2-21

Chapter 2

Disassembly and reassembly of major components

SECTION 1. GENERAL PRECAUTIONS FOR SEPARATION AND REINSTALLATION

1.BEFORE OPERATION

1) Always be safety-conscious in selecting clothes to wear and suitable tools to use.

2) Before disassembly, be sure that you familiarize yourself with the assembled condition for subsequence in reassembly.

3) Keep parts and tools in proper order during operations.

4) When servicing electrically charged parts,be sure to disconnect the negative battery terminal.

5) To prevent oil or water leaks,use the liquid gasket as required.

6) When lifting up only the front or rear part of the tractor,be sure to wedge the grounded wheels.

8) When the tractor is jacked up, be sure to support the entire tractor with something like a stand.Lifting it up with a jack only is dangerously unstable procedure.

9) When replacing parts,use authorized, genuine TYM parts only.TYM assumes no responsibility for accidents,operating problems or damage caused by the use of imitation parts.

Also,the use of unauthorized parts will result in relatively poor machine performance.

2. PRECAUTIONS TO BE FOLLOWED WHEN INSTALLING STANDARDIZED PARTS.

(1) Roller or Ball bearings

1) When a bearing is fitted in by the outer race ,use an installer which is an specially designed to push only the outer race and vice versa.

2) The installer must be designed to install the bearing on the shaft in a parallel position.

3) When installing a bearing which appears the same on both sides, install it so that the face which has the identification number faces in a direction for easy visual identification.All the bearings which are to be installed in the transmission case should be placed so that their identification number faces outward.

4) If a shaft or hole where a bearing is to be installed has a stopper, the bearing should be pushed in completely until it is seated against the stopper.

5) Installed bearings should turn smoothly.

(2) Oil seals

1) Oil seals installer should be designed so as not to deform the oil seals.

2) During installation,be careful not to damage the lips,and assure that it is pushed in parallel to the shaft or hole.

3) When oil seals are installed,there should be no turnover of the lips nor dislocation of the springs.
4) When a multi-lip seal is installed, the grooves between lips should be filed with grease, not adhesive.

(3) O-rings

1) O-rings should be coated with grease before installing.
2) Installed O-rings should have no slack or twist.
3) Installed O-rings should maintain proper air tightness.

(4) Snap rings

1) Snap ring installers should be designed so as not to permanently deform the snap rings.
2) Installed snap rings should be seated securely in the groove.
3) Be careful not to overload the snap ring to the extent that it is permanently deformed.
4) How to install the snap ring:
When installing a snap ring,install it as shown in the figure with its round edge side turned toward the part to be retained.
This round edge is formed when the snap ring is pressed out.

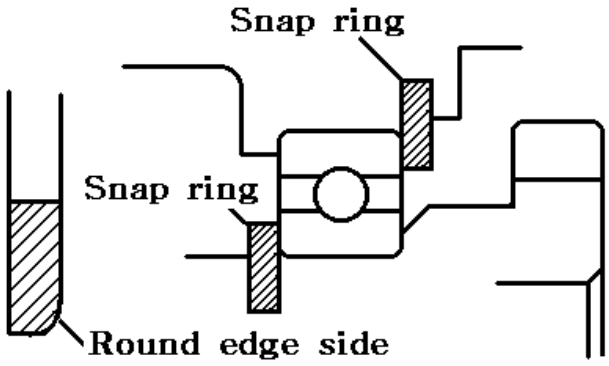


Fig.2-1

(5) Spring(roll) pins

1) Spring pins should be driven in properly as tightly.
2) Spring pins should be installed so that their seams should face the direction from which the load is applied.

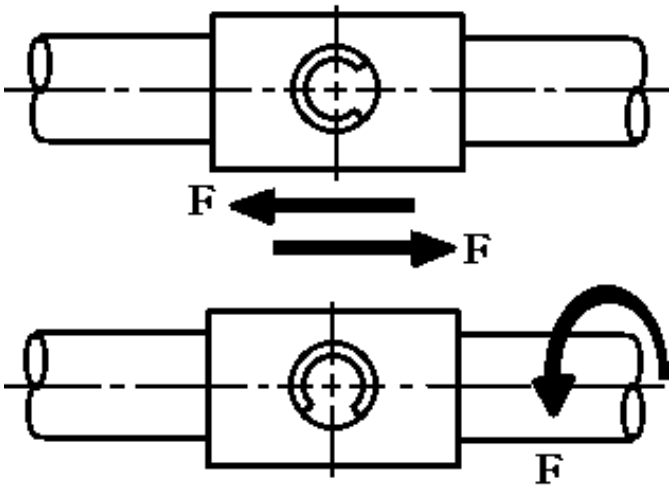


Fig.2-2

3) The roll pins installed in the transmission or other parts where much force is applied should be retained with the wire.

(6) Cotter pins

When installed, cotter pins should be bent securely at the ends as shown in the figure

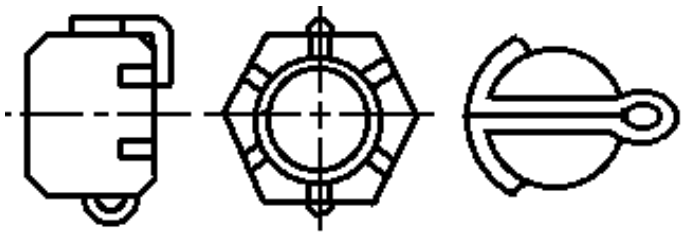


Fig.2-3

(7) Bolts and nuts

1) Special bolts are installed at several locations ,so be sure not to interchange them other bolts.
2) Bolts and nuts should be tightened to their specified torque wrench.
3) When locking the bolts or nuts with wire or a lock washer,

,Be sure to wind the wire paying sufficient attention to its winding direction and bend the lock washer for secure looking.

4) When locking bolts and nuts with an adhesive,apply the adhesive on the thread and tighten securely.

5) Apply an adhesive(THREE BOND TB1104) to parts through which there is any possibility of oil leaks,such as stud bolts and tapped-through parts.

6) Each lock nut must be tightened securely.

7) When tightening bolts and nuts, refer to the tightening torque table.

(8) After installation, each grease fitting should be filled with grease.

1) When installing grease fittings of type B and C,be sure to turn the fitting tips in a direction that will provide easy access for a grease gun.

(9) Other precautions

1) Be sure not to damage any finished surfaces or parts.

2) Always refrain from forcing installation.

3) Each lever knob should be installed coated with an adhesive (SUPER THREE CEMENT TB1702)

4) Each contact surface should be coated with an adhesive (THREE BOND TB 1215) and tightened evenly with bolts.
Adhesive coated surfaces should be installed within 30 minutes after application of the adhesive.

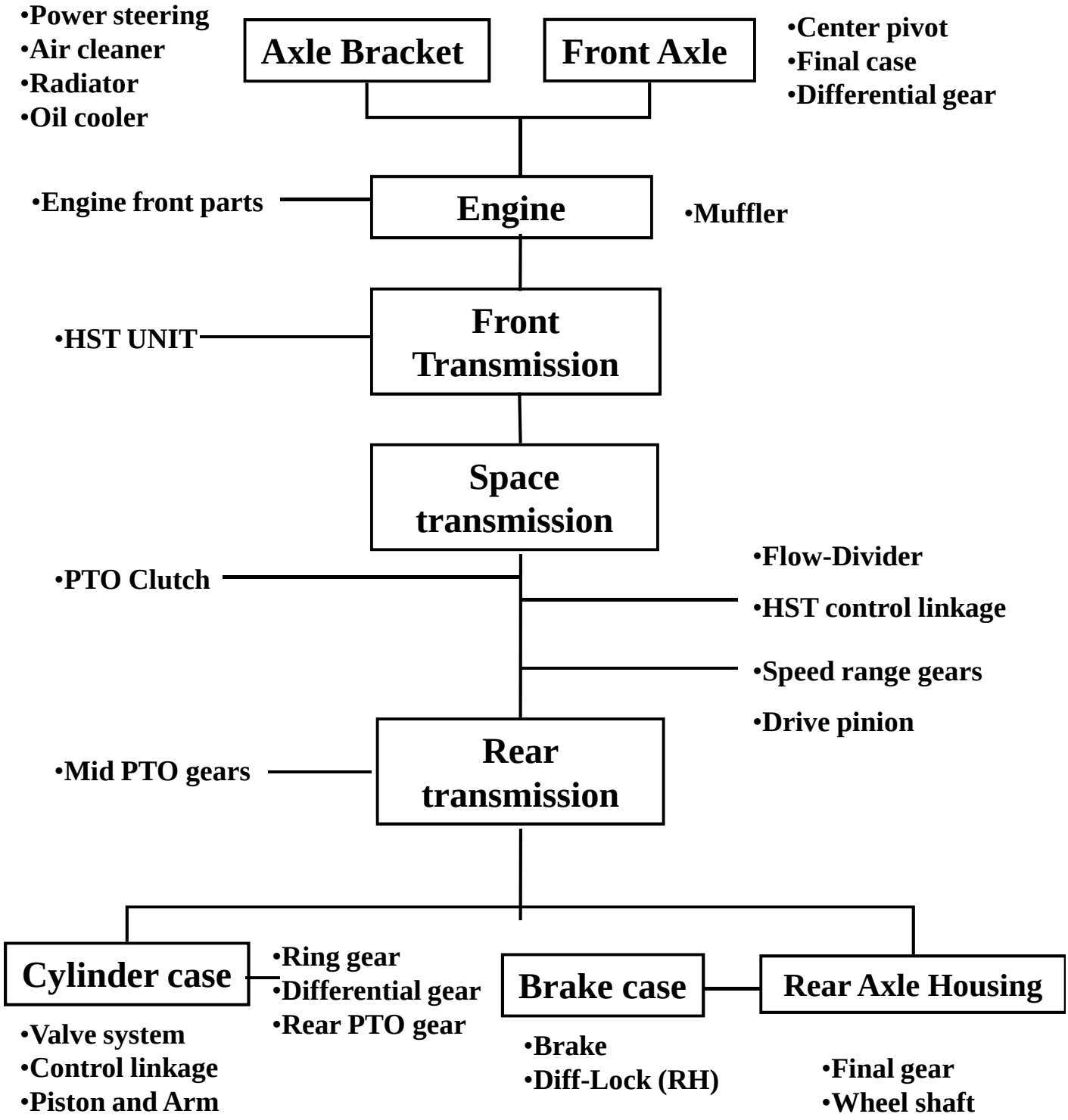
The contact surfaces should be flawless and free from foreign matter,and especially from grease before application of the adhesive.

5) Precautions for applying adhesives.

- The surface or the thread where and adhesive is to applied should be completely free of chips.

- The surface or the thread where an adhesive is to be applied should be completely free of oil-ness.

SECTION 2. OPERATION CHART FOR DISASSEMBLY AND REASSEMBLY BY MAJOR BLOCKS



SECTION 3. SEPARATION OF MAJOR COMPONENTS

1.SEPARATION OF THE FRONT AXLE AND AXLE BRACKET

Parts which can be inspected during This operation
-Center pivot
-Final case
-Differential gear

(1) Removal
1) Hold the front hitch or the front bracket securely with a crane or stands.
2) Support the front axle with a jack
3) Remove both right-hand and left-hand tie rods.
4) Remove the pivot metal bolts.
5) Remove the front axle assembly forward.

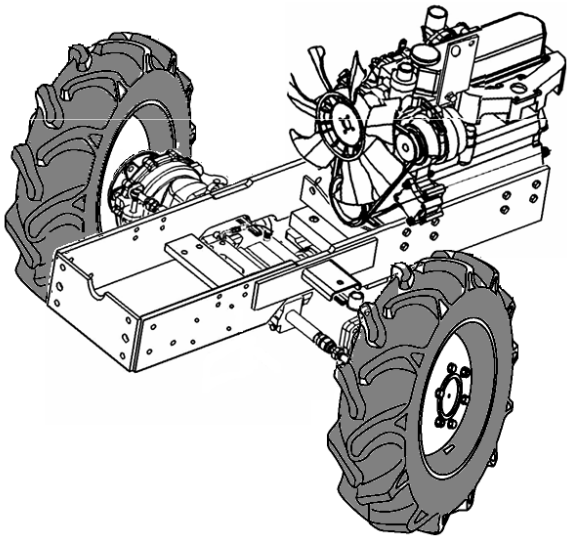


FIG.2-4 Front axle

Note:
When working on the 4WD version,the drive shaft should be removed ahead of time.

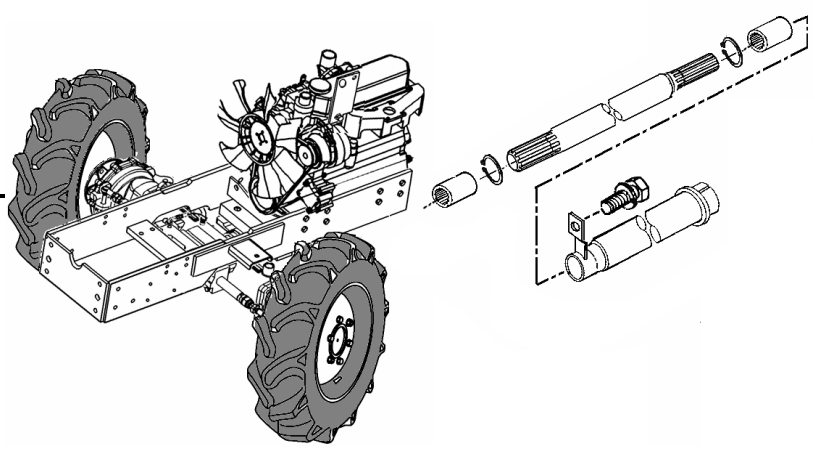


FIG.2-5 Drive shaft

(2) Installation
1) Install the front axle assembly.

2) Install both pivot metals(supports)

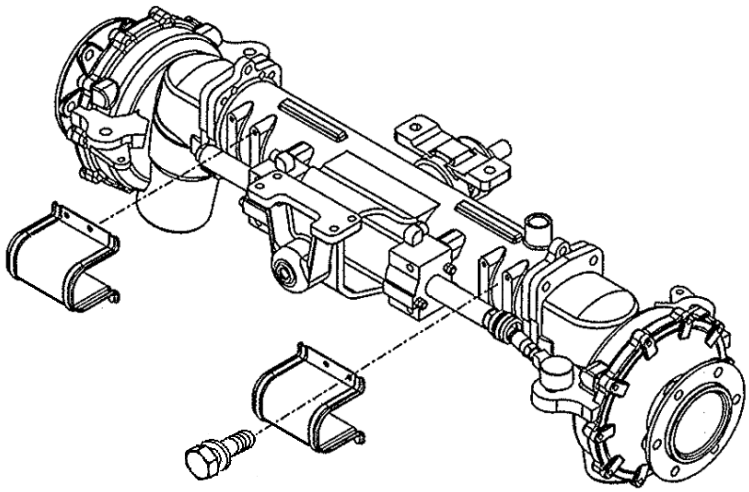


FIG.2-6 Front axle

Note:

Apply grease to the bushing and fill the oil seal with grease ahead of time.Install the oil seal carefully not to allow its lips to turn over.

3) install both of the right and left tie rod.

2.SEPARATION OF THE ENGINE AND THE FRONT AXLE BRACKET

Parts which can be inspected during This operation
-Air cleaner
-Radiator
-Power steering system
-Oil cooler
-Engine front part.

(1) Removal
1) Hold or support the engine with a crane or stands.
2) Hold or support the front bracket or the axle bracket in a manner that the part other than the engine can be removed if required.
3) Remove the damper and Engine hood

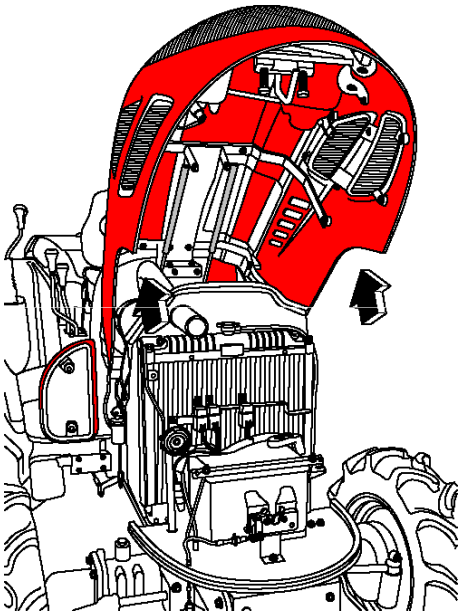


FIG.2-7 Wiring harness

4) Disconnect the positive and negative battery cables.

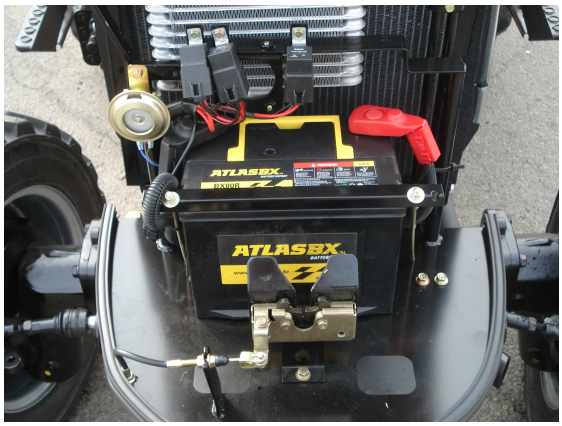


FIG.2-8 Battery

5) Open the front grille.
6) Detach the head light wiring.
7) Remove the other wiring
8) Remove the inlet pipe from the air cleaner.
9) Remove the air cleaner.

Note:
Here the air cleaner can be removed as an assembly.

10) Remove the upper hose,lower hose.and drain hose from the radiator.

Note:
The radiator should be drained of the coolant ahead of time.
11) Remove the fuel filter.

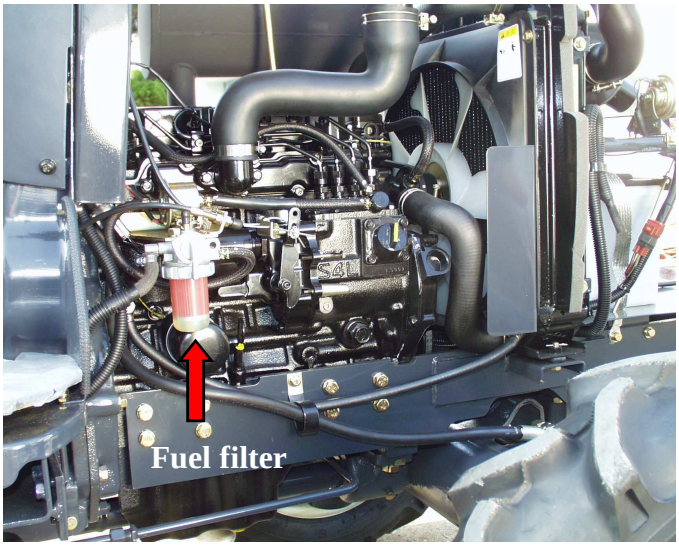


Fig.2-9 Fuel filter

12) Remove the radiator and oil cooler from the axle bracket

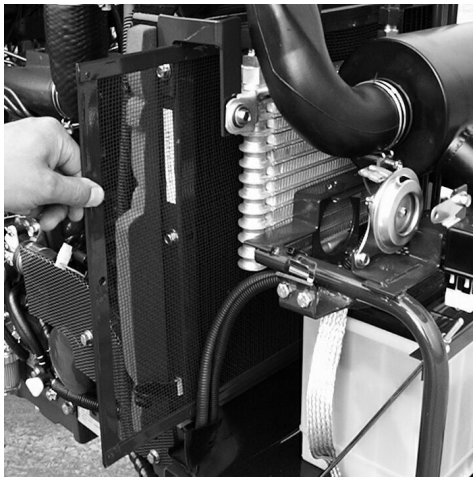


Fig.2-10 Oil cooler

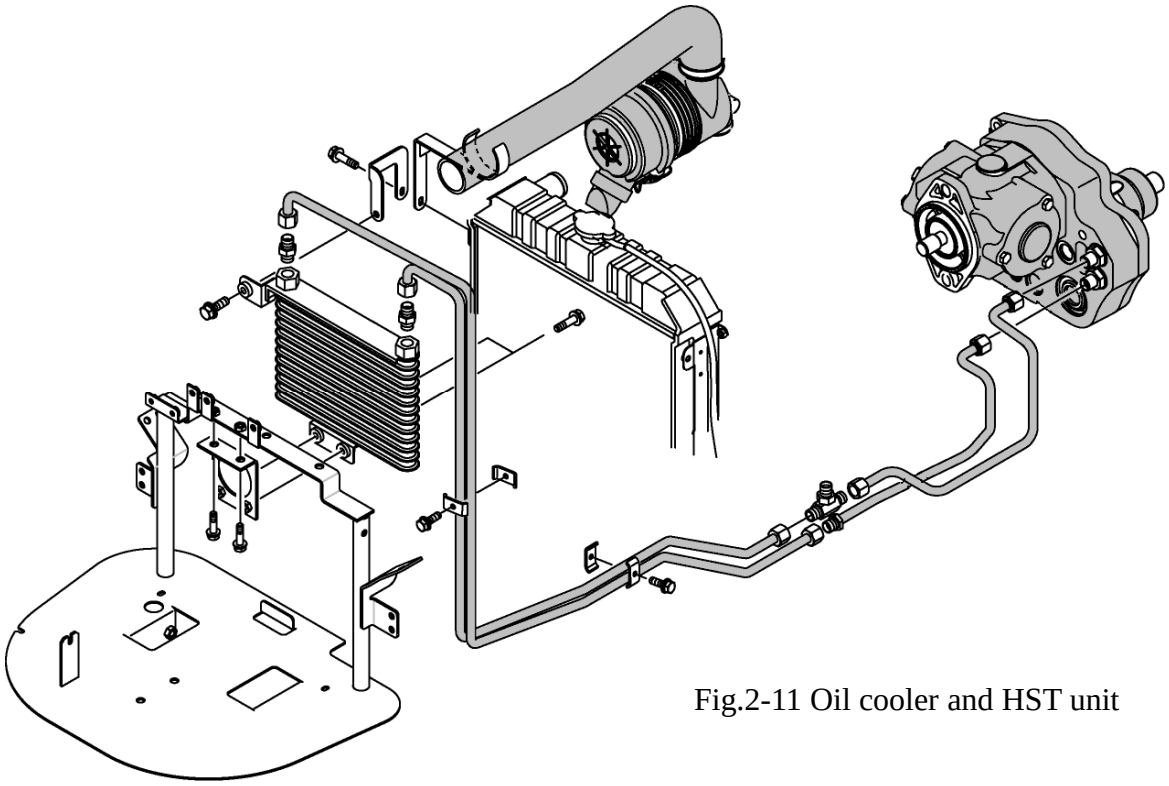


Fig.2-11 Oil cooler and HST unit

13) Remove the battery and battery bracket.
14) Remove the two hoses for the power steering system.
15) Remove the mounting bolts of the right hand pivot metal(support) ahead of time.
16) At this stage,the power steering unit can be removed by disconnecting both right-hand and left hand tie-rods and removing the unit mounting bolts.

Note:

When the pipes related to the hydraulic system are removed,their openings should be covered with plastic caps or the like to keep out dust or other foreign matter.

(2) installation

Reassemble in reverse order of removal.
1) Install the axle bracket on the engine.
2) Retighten the right-hand pivot metal (support) mounting bolts.
3) Connect the piping of the power steering system.
4) Install the battery bracket and battery.
5) Install the radiator and oil cooler on the front axle bracket.
6) Connect the upper, lower and drain radiator hoses.
7) Install the air cleaner assembly and the inlet pipe of the air cleaner.
8) Connect the wiring of the head lights and other harness.
9) Connect the ground strap and the battery cables.
10) Install the engine hood.
11) Install the side covers.
12) Fill the radiator with coolant.

3.SEPARATION OF THE ENGINE AND THE FRONT TRANSMISSION.

Parts which can be inspected during this operation.
-Fly wheel
-HST unit

(1) Removal

1) Drain the transmission of the oil (In the case of the 4WD version),remove the front wheel drive shaft.

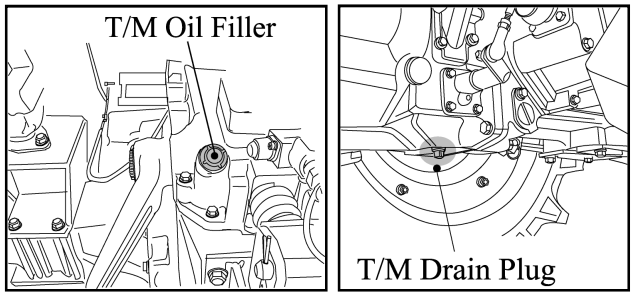


FIG.2-12

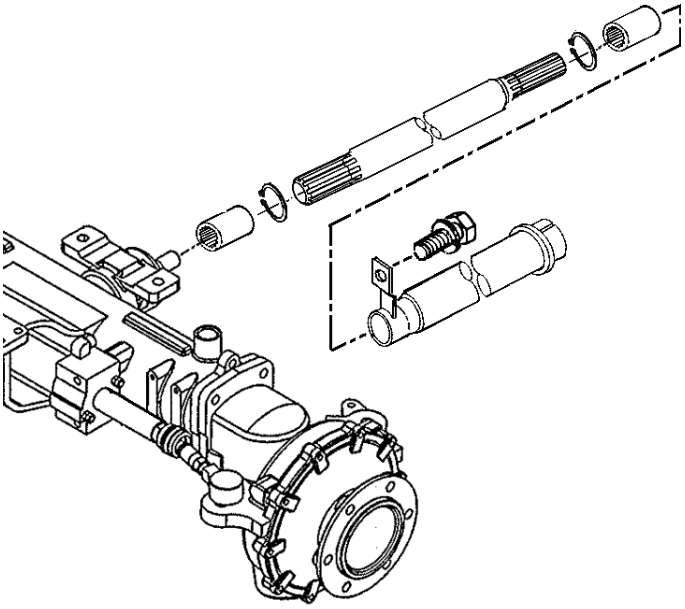


FIG.2-13

2) Support the engine on the bottom with a jack or stands.
3) Hold the transmission with a garage jack or a crane so that the transmission side can be moved when needed.

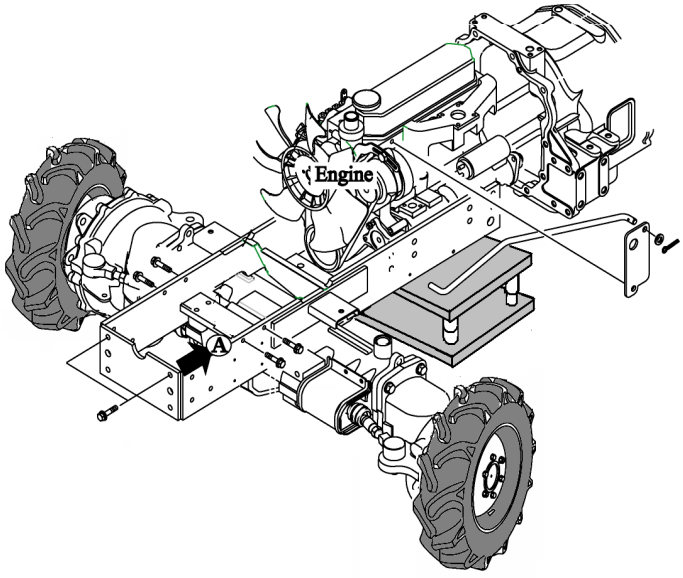


Fig.: Stands

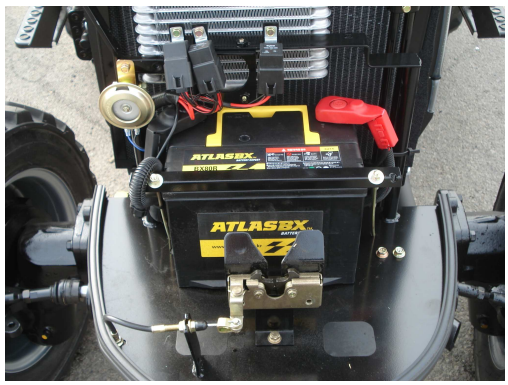


FIG.2-14

4) Disconnect the panel instrument set removing bolts(4 nos.)

FIG.2-15

Note:
-Tilt the steering column rearwards.
-Lift up the panel set and disconnect the wiring couplers.

5) Remove the cover.

FIG.2-16

6) Disconnect the hydraulic hose from the power steering (orbitrol)

Note:

- Disconnect the linear shift control cable
- Disconnect the cable from both the steering lever side and transmission.

7) Remove the mounting bolts and dismounting the dash panel

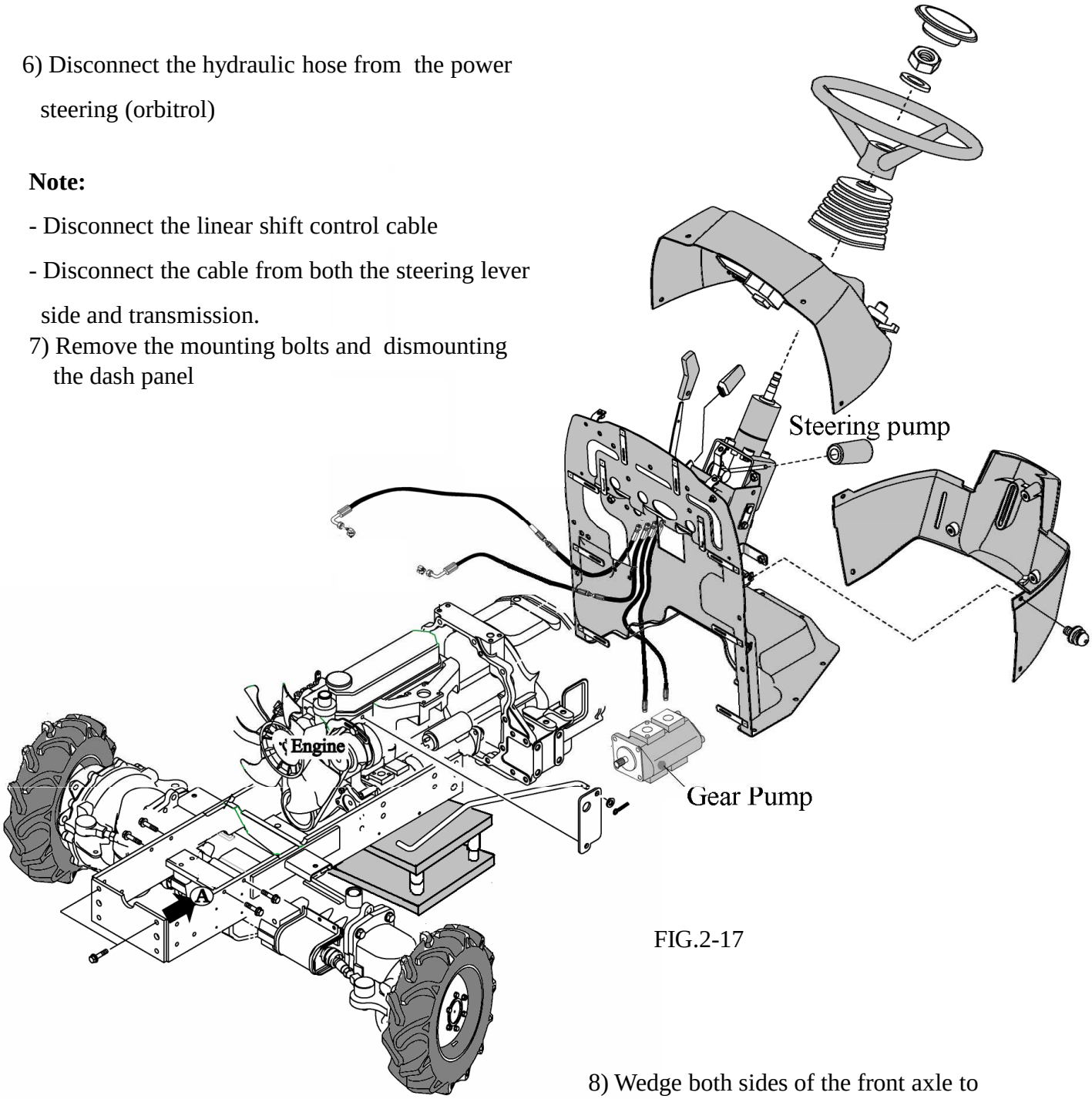


FIG.2-17

8) Wedge both sides of the front axle to prevent the engine from tilting.

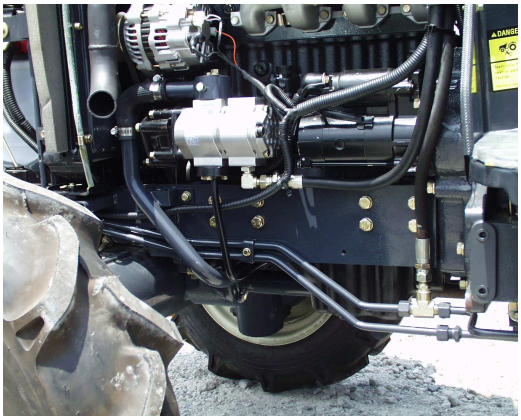


FIG.2-18 hardware Disassembly

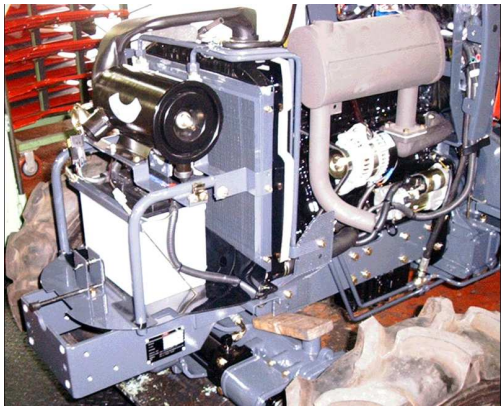


FIG.2-19 Wedging

8) Disconnect the rubber hose from the suction pipe.

(2) Engine separation from the chassis.

When separating the engine from the chassis, the following steps are required as well as the ones mentioned above.

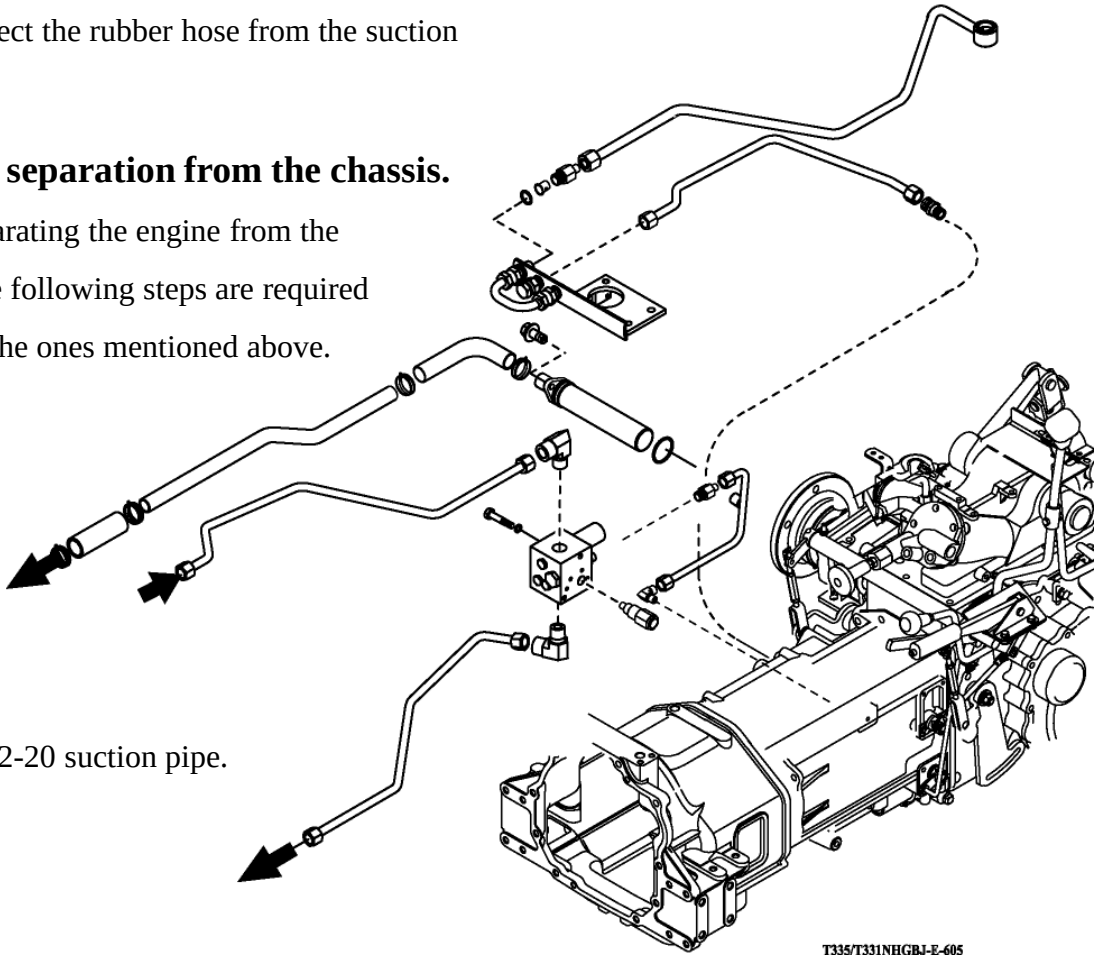


FIG.2-20 suction pipe.

1) Lift the engine with the hoist and hold the front axle bracket with a stands or the like.
2) Disconnect the upper, Lower ,and drain hoses from the radiator.
3) Disconnect the two power steering system hoses.

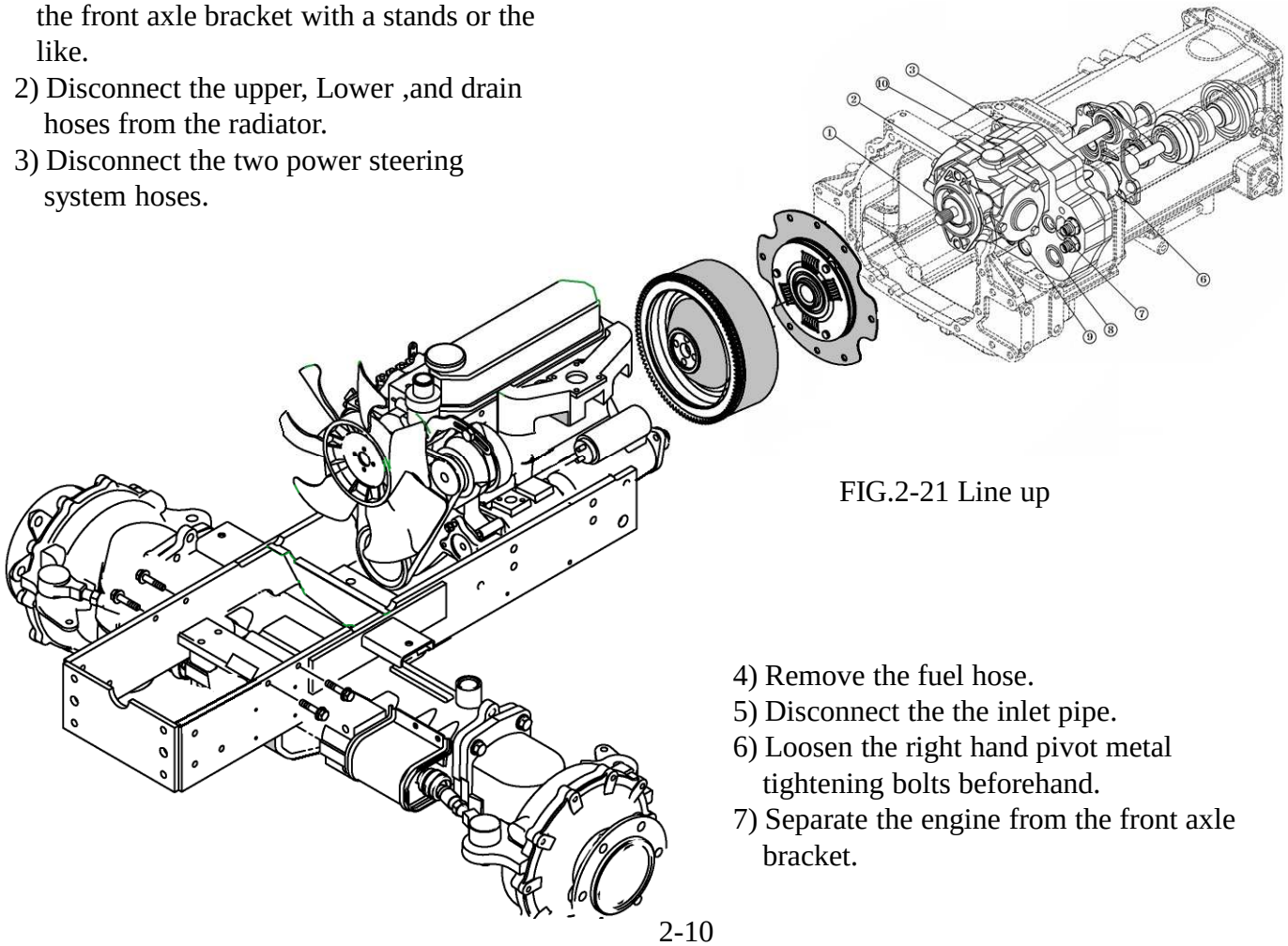


FIG.2-21 Line up

4) Remove the fuel hose.
5) Disconnect the the inlet pipe.
6) Loosen the right hand pivot metal tightening bolts beforehand.
7) Separate the engine from the front axle bracket.

(3) INSTALLATION

REASSEMBLY IN REVERSE ORDER OF REMOVAL.

1) Install the engine on the front axle bracket.
2) Retightening the right hand pivot metal tightening bolts.
3) Connect hoses.
4) Assemble the engine and the front transmission.

Note:

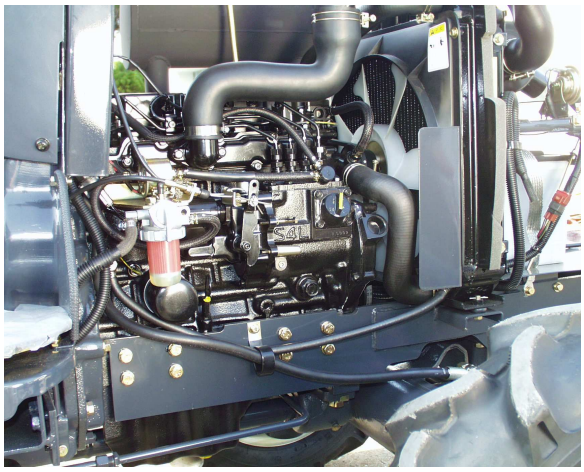
- Apply small mount of grease to each of the sliding parts. Be careful not to apply excessive amount of grease as this could cause clutch slipping.
- During operation, be sure to avoid any of the reassembly operations that may place load upon the input gear.

5) Install the hydraulic system piping.
6) Install the dash panel.
7) Install the wiring and rods.
8) Install the covers.
9) Connect the panel set wiring and then install the panel.
10) Connect the wiring for the engine.
11) Connect the battery terminals.
12) Install the engine hood and side cover.
13) Remove the clutch housing and engine tightening bolts and move the engine forward.

4.SEPARATION OF THE FRONT TRANSMISSION AND SPACER TRANSMISSION

Parts which can be inspected during This operation
-HST unit
-PTO clutch

1) Removal
A:Removal of the whole floor.
1) Remove the side covers(LH and RH).
2) Disconnect the negative battery cable.
3) Detach all the wiring relevant to the removal of the floor.



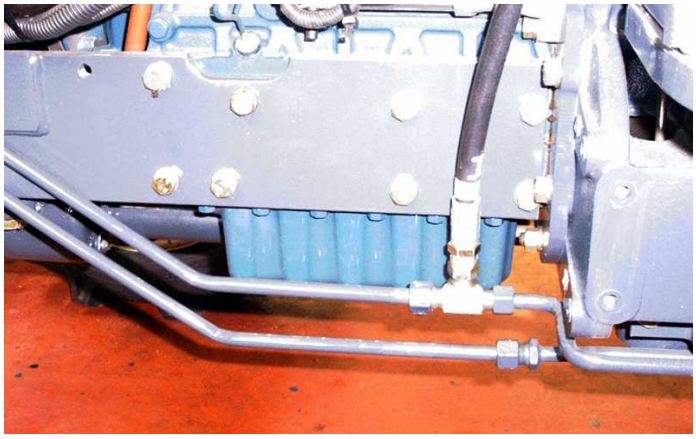


FIG.2-22

4) Disconnect the throttle lever cable from the fuel injection pump and accelerator pedal cable from the pedal.
5) Disconnect the clutch rod and brake rods under the floor.
6) Disconnect the steering cylinder at the hydraulic pump

7) Remove the slow-return check valve knob

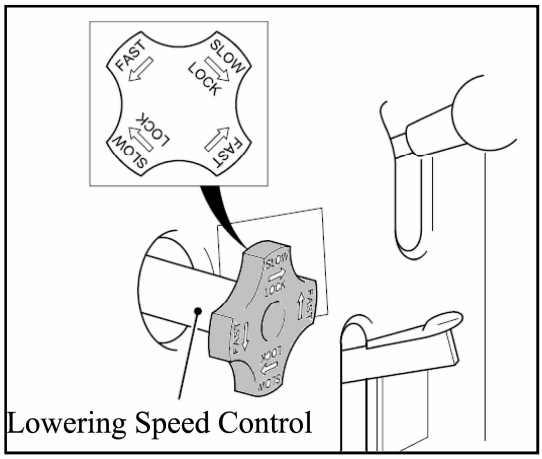


FIG.2-23 Slow return check valve

8) Remove the remote control valve lever

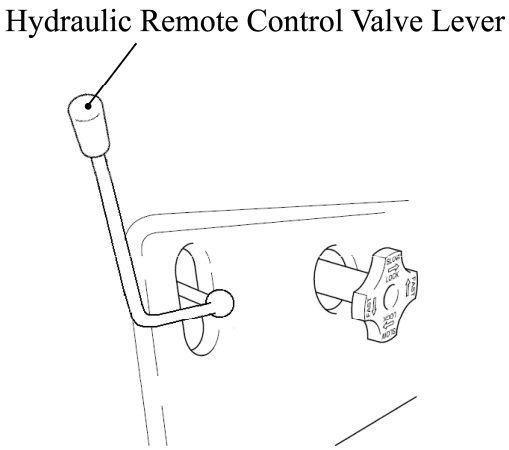


FIG.2-24 remote control valve lever

9) Remove the diff-lock pedal

FIG.2-25 Diff-lock pedal

10) Remove the parking brake.

11) Remove the main shift and transmission range shift levers.The levers can be separated in the middle.

12) Remove the control rods of the PTO shift and 4WD shift levers from the transmission.

13) Remove the position control levers.

FIG.2-26 Range shift lever

FIG.2-27 position control lever

14) When the tractor is equipped with an optional remote control valve,remove the remote control valve link.

15) Drain the fuel system of fuel.

16) Remove four rubber mounts.

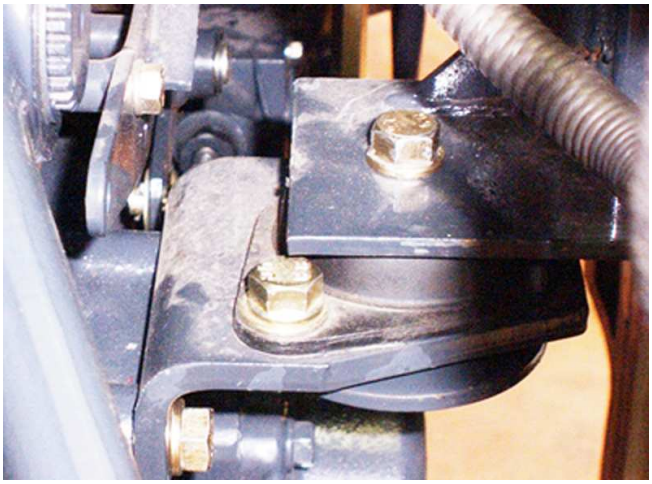


FIG.2-28 Rubber mounting

17) Lift up the floor slightly with a hoist.

18) Disconnect the linear shift control cable, fuel hoses,and gauge coupler between the fuel tank and floor.

19) Disconnect the pipe relevant to the HST tank.

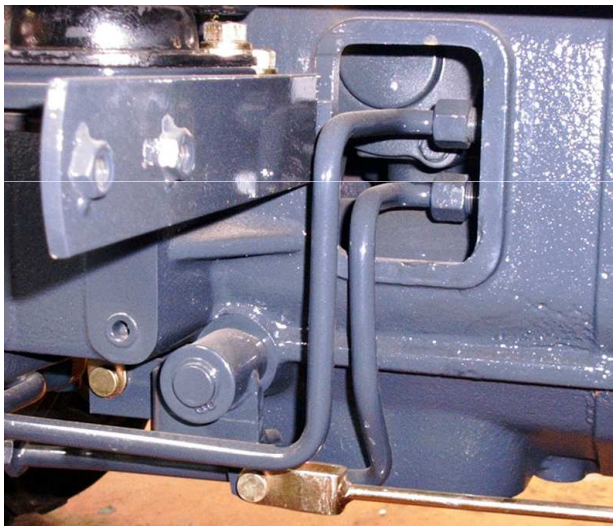


FIG.2-29

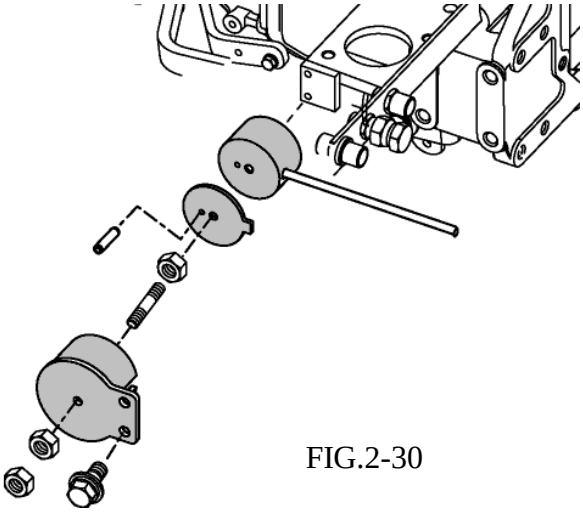


FIG.2-30

20) Lift the floor gradually taking care not to allow the shaft of the slow return check valve and its hole in the floor to interfere with each other.

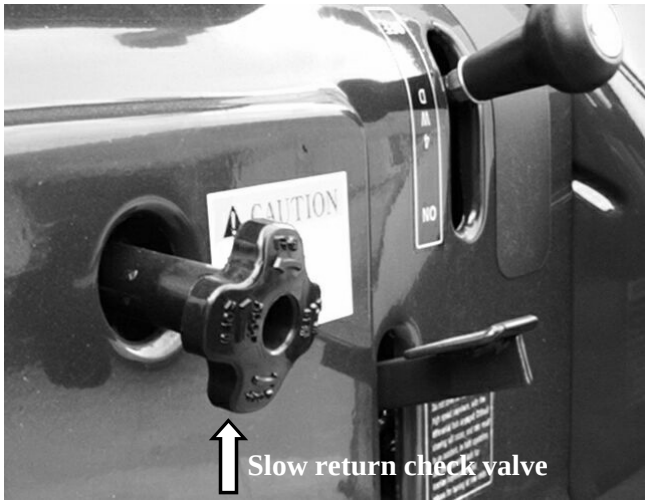


FIG.2-31 Slow return check valve

Note:
Lift up the floor gradually making sure that all relevant wiring. Piping, and links are disconnected.

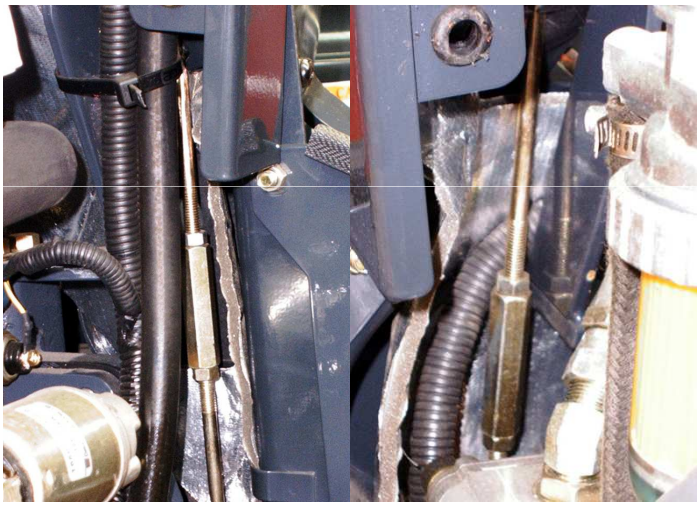


FIG.2-32 Brake pedal (Rod comp)

B: Division of the chassis.
1) Drain the transmission of oil
2) Remove the front wheel drive shaft

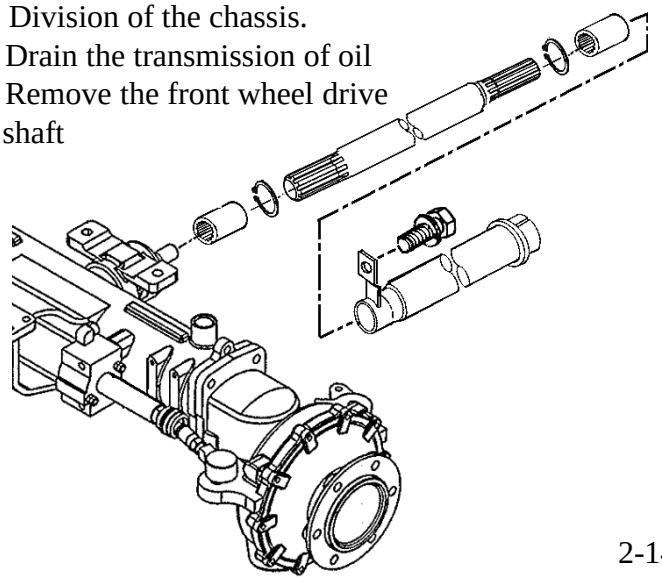


FIG.2-33 Front wheel drive

3) Disconnect the brake rods.

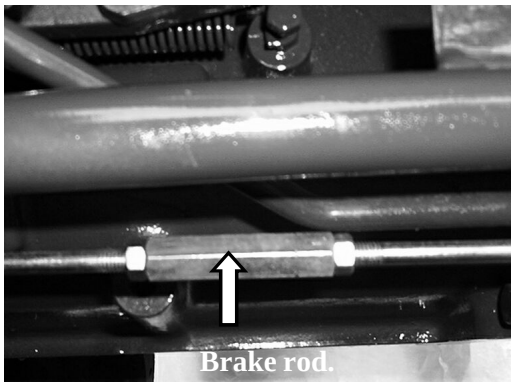


FIG.2-34 Brake rod.

4) When the tractor is equipped with an optional remote control valve ,remove the remote control piping.

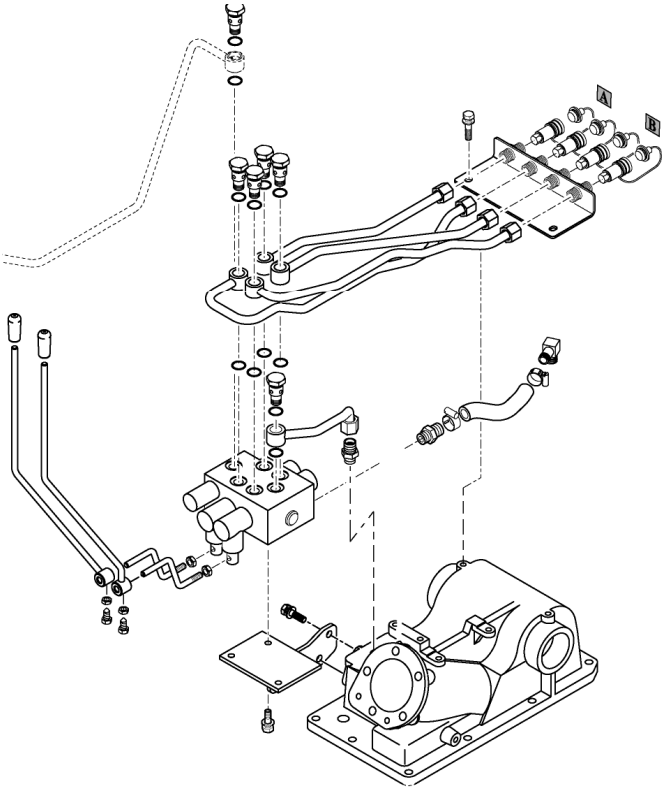


FIG.2-35 Optional remote control valve

5) Remove the suction and delivery pipes.
6) Remove the delivery pipe for the PTO clutch.
7) Remove the 4WD shift metal

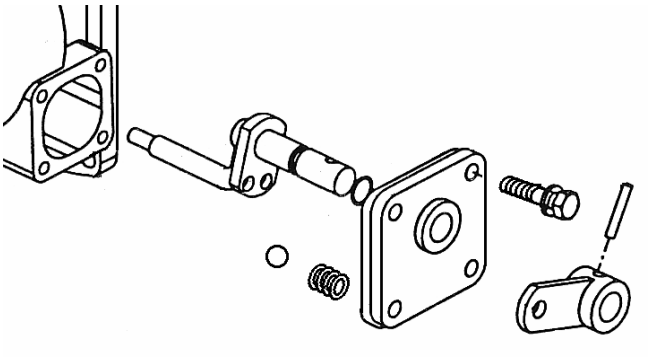


FIG.2-36 4WD shift metal

8) Remove the HST unit from the front transmission case.
9) Hold the clutch housing and space transmission case with a crane or jack.
10) Remove the bolts which tighten the front transmission and spacer transmission cases.
11) Move the rear part of the tractor rearwards by turning the rear wheels by hand, and then the spacer and rear transmission assembly will be separated from the front transmission.

Note:
When moving the rear part of the tractor. be careful not to allow the garage jack to shift from the spacer transmission case.

Remark
The rear transmission and spacer transmission cases should be separated and the reverse shift metal(support) removed in order to take care out or provide access to the main shift and transmission range shift gears. For further details,refer to Chapter 5. Transmission.

2.installation
Reassemble in reverse order of disassembly.
(1) Assemble the front and spacer transmission. Make sure that the turning lock of the PTO clutch is securely seated in the groove in the spacer transmission case.
(2) Install the reverse shift metal(support)
(3) Install the PTO clutch delivery piping.
(4) Install brake rods.
(5) Install the Oil damper Assy.
(6) Install the forward arm and Reverse arm comp

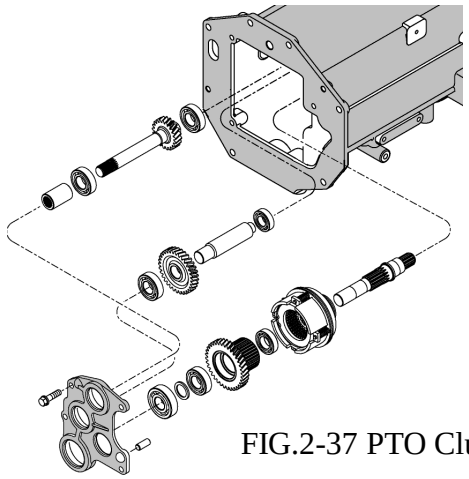


FIG.2-37 PTO Clutch

(7) Install the front wheel drive shaft.
(8) Position the floor taking care not to allow wiring or other parts to be pinched under it
(9) With the floor lifted up a little, install the fuel hose and fuel gauge coupler on the fuel sub-tank and connect the linear shift control cable.
(10) Fix the floor at the four rubber mounts.
(11) Install all levers,knobs, and Rods.
(12) Connect the power steering wheels.
(13) Connect the accelerator wires.
(14) Install wiring
(15) Connect the negative battery cable.
(16) Install the side covers(RH and LH)
(17) Fill the transmission case with oil
T303/T353HST: 35ℓ

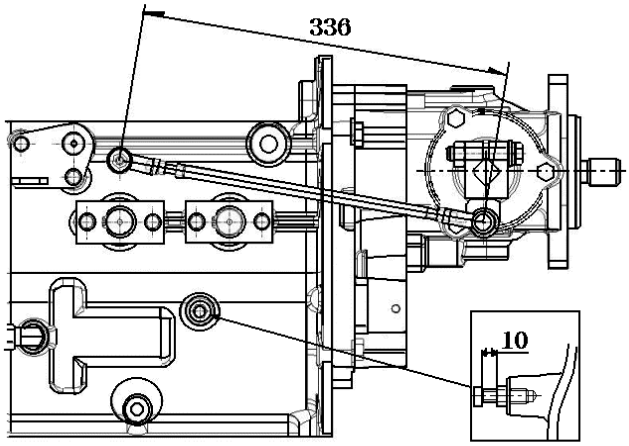


FIG.2-38 Rod assy

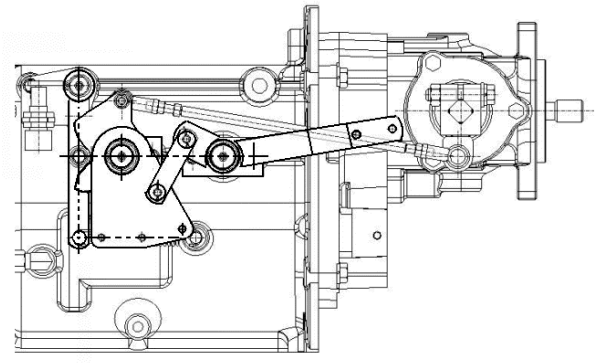


FIG.2-39 forward and Reverse arm

5.SEPARATION OF THE SPACER TRANSMISSION AND REAR TRANSMISSION

Parts which can be inspected during This operation
-Drive pinion gear
- Speed range gear (Transmission range shift)
- HST control linkage.
- MID PTO Gears.

1) Removal
(1) remove side cover(LH and RH)
(2) Disconnect the negative battery cable
(3) Remove the slow-return check valve knob.

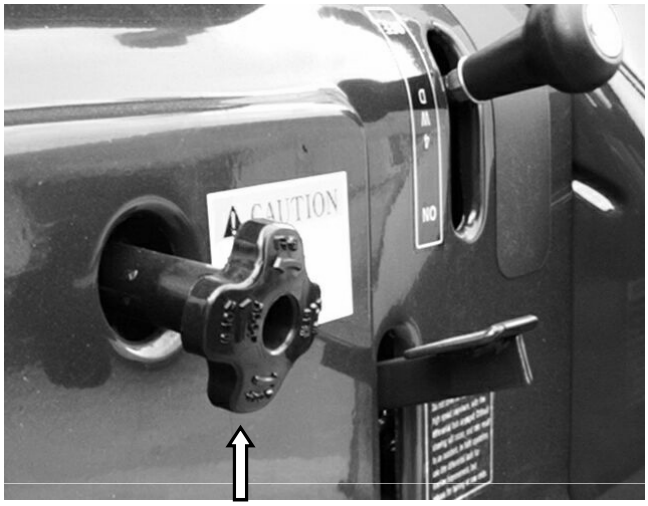


FIG.2-40 slow return check valve knob

(4) Remove the diff-lock pedal
(5) Remove the parking brake
(6) Remove the speed range shit and transmission range shift levers.
The lever can be separated in the middle
(7) Disconnect the PTO change and 4WD change rods from the transmission.

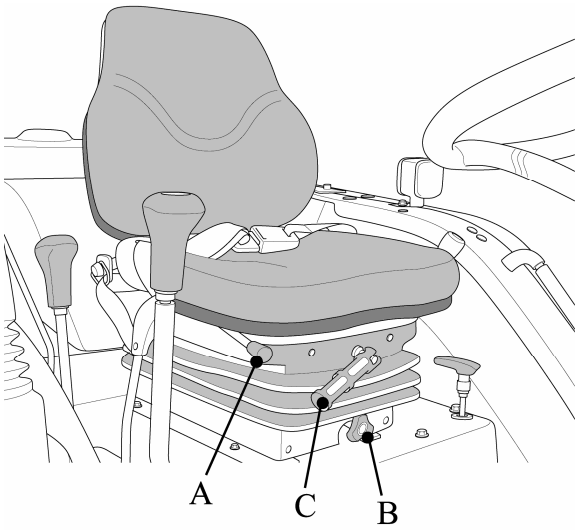


FIG.2-41 operator's seat

(8) Remove the operator's seat
(9) remove the position control lever
(10) Remove the lever guide.
(11) When the tractor is equipped with an optional remote control valve,remove the remote control valve and relevant parts from the bracket.

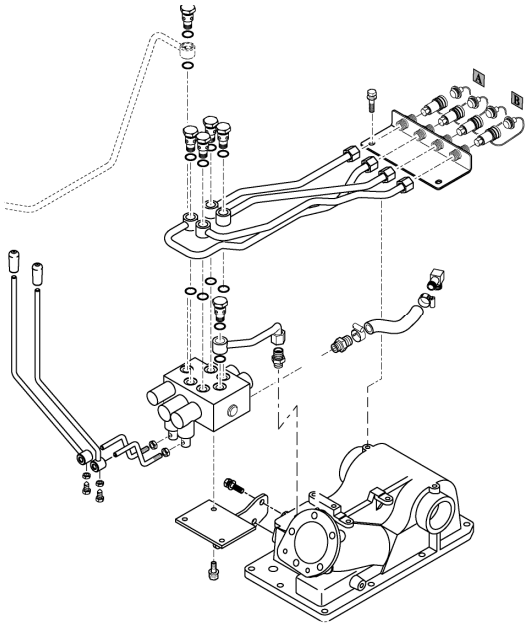


FIG.2-42 Remote control valve (optional)

(12) remove the back panel.
(13) remove the fuel tank cover
(14) Drain the fuel of fuel tank.
(15) Remove the fuel tank and tank stay.
(16) Remove the floor frame.
(17) Drive in a chock between the front axle housing and axle bracket.

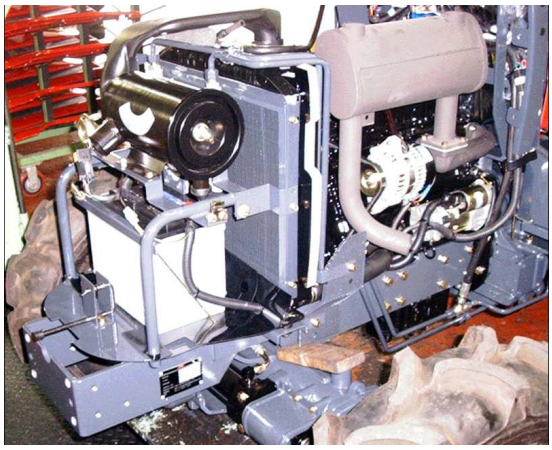


FIG.2-43.Chock

(18) Place a jack under the bottom of the spacer transmission case to support
(19) Lift up the rear transmission and remove the right and left rear wheel

(20) Remove two rubber mounts.

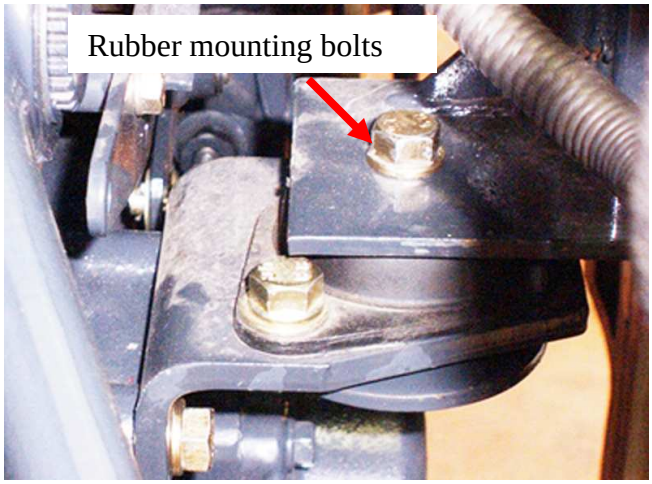


FIG.2-44 Frame rubber mounts.

(21) Lift up the rear end of the floor/fender assembly by about 10 mm,and place wood between the spacer transmission case and floor panel
(22) Drain the transmission of oil
(23) Remove the assembly of the remote control valve and piping.
(24) Remove the forward and reverse pedal
(25) Remove the oil damper assembly
(26) Remove the forward and reverse arm

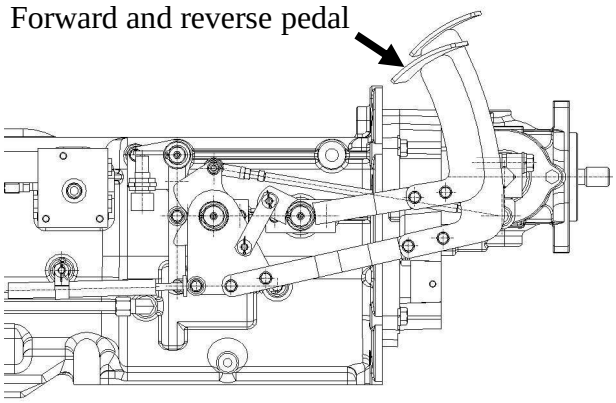


FIG.2-45 Forward and reverse pedal

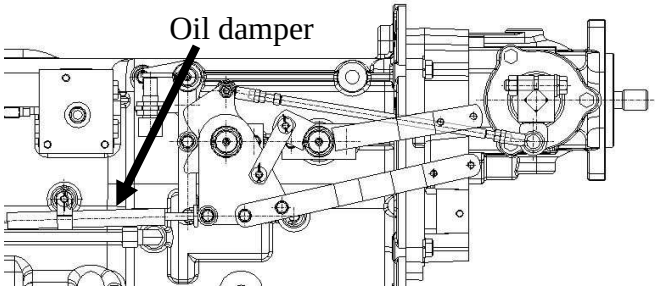


FIG.2-46 Oil damper

(27) Remove magnetic cruise.
(28) Remove MID PTO stopper assembly

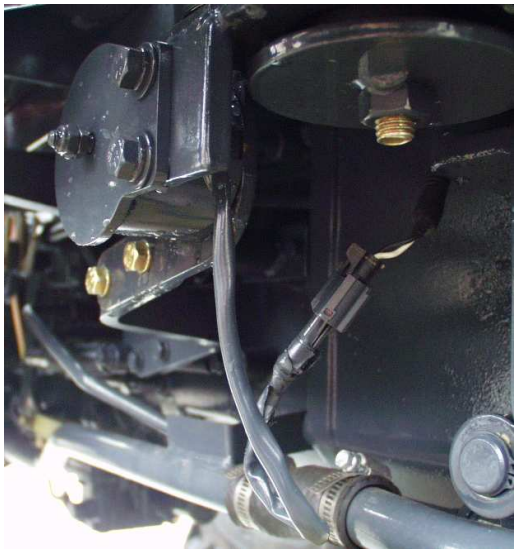


FIG.2-47 magnetic cruise

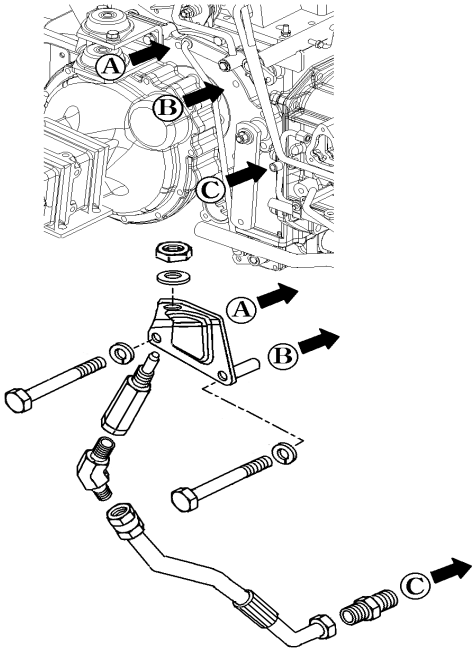


FIG.2-48 MID PTO stopper

(29) Remove the front wheel drive shaft
(30) Remove the brake rods.
(31) Remove the 4WD shift metal

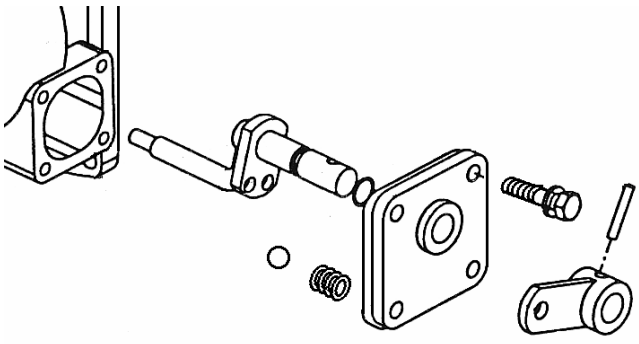


FIG.2-49 4WD shift metal

(32) Remove all the spacer-rear transmission case tightening bolts and nuts except the bottom bolt.

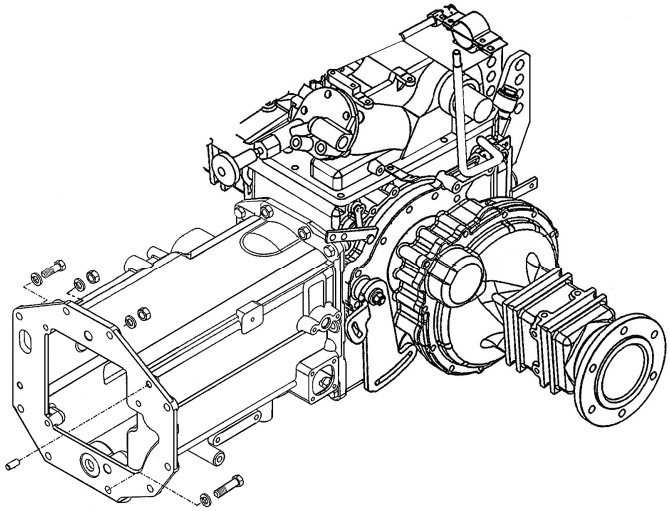


FIG.2-50 space transmission bolt

(33) Install the rear wheels(LH and RH) and the remained bolts.Then turn the rear wheels by hand to move the rear transmission case away from the spacer transmission case.

2) Installation

Reassemble in reverse order of disassembly.

Note:

•The 4WD drive shaft should be installed on the rear transmission ahead of time.

(1) Join the rear and spacer transmission cases.

Note:

During the operation,be careful not to damage needle bearings, the cut –away part in the gear should be turned downward without fail so as to clear the gear to be positioned underneath.

(2) Install the main change shifter link and each change metal.
(3) install the brake rods and front drive shaft.
(4) Install the hydraulic piping.
(5) Install the 4WD shift metal
(6) Install the MID PTO stopper assembly
(7) Install the forward and reverse arm.
(8) Install the oil damper assembly
(9) Install the forward and reverse pedal.
(10) Install two rear rubber mounts.
(11) Install exterior parts.
(12) Fill the transmission case with oil
T353HST: 35ℓ

6.SEPARATION OF THE REAR TRANSMISSION AND REAR AXLE HOUSING

Parts which can be inspected during This operation

- Diff Lock
- Brakes
- Brake cases
- Final gears
- MID PTO gears.

1) Removal

As both sides can be disassembled in the same way,only side with the diff-lock installed will be explained here.

(1) Drain the transmission case of oil
(2) Lift up the rear transmission and remove the rear wheel on the diff-lock side.

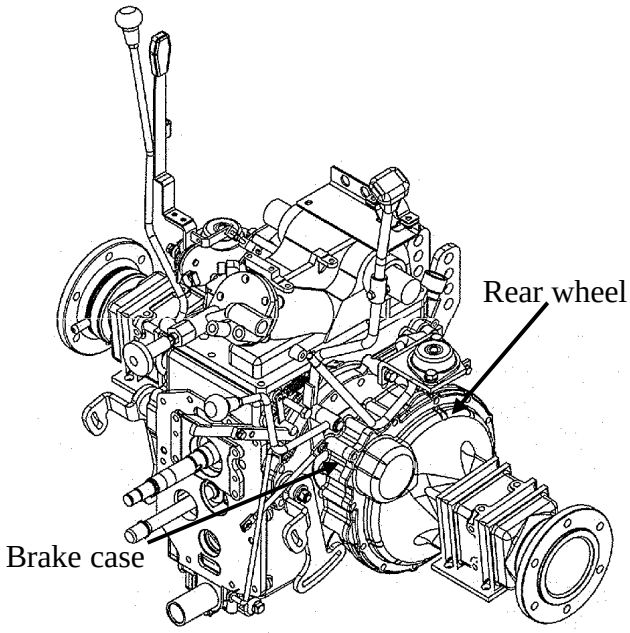


FIG.2-51 Rear wheel and brake cases.

(3) Remove the diff-lock pedal

FIG.2-52 Diff-lock pedal

(4) Remove the brake rods.
(5) Remove the 3-point linkage and related parts.

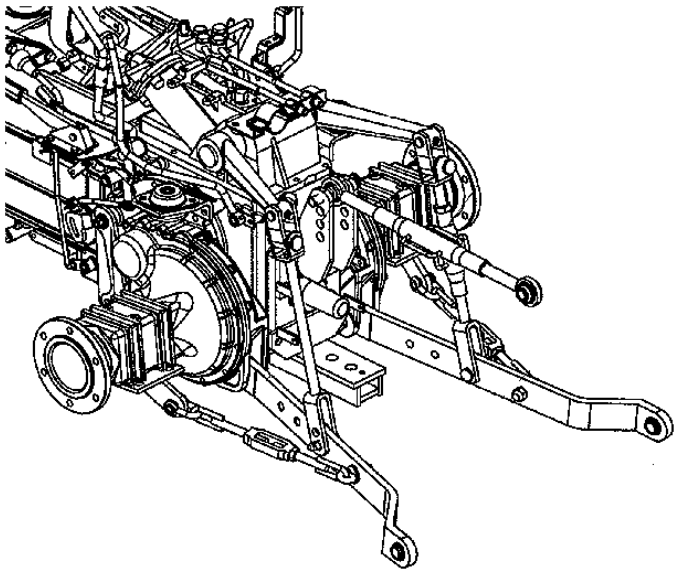


FIG.2-53 3-point linkage

(6) Support the floor panel with a trestle or the like.
(7) Remove the rubber mount along with the bracket.

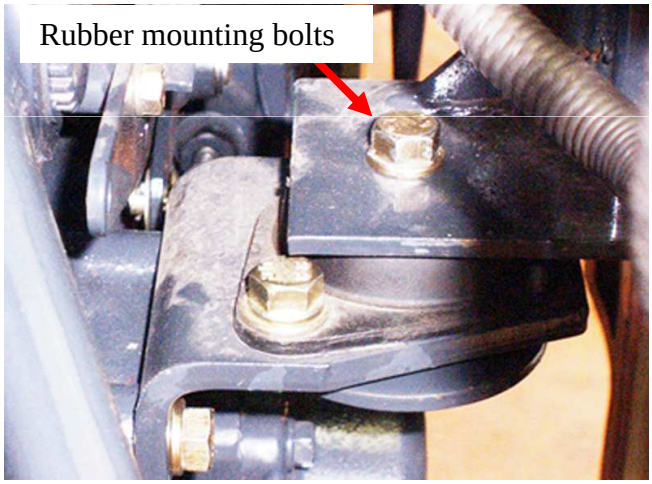


FIG.2-54 Frame rubber mounts.

(8) Remove the rear axle housing tightening bolts.
(9) Remove the brake case from the rear transmission case.
(10) Detach the brake assembly from the rear transmission case.

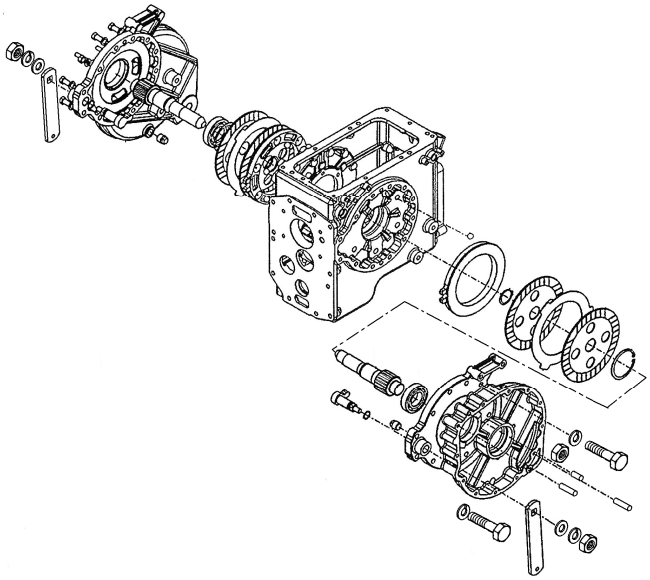


FIG.2-55 Brake

2) Installation
Reassemble in reverse order of disassembly.
(1)Install the brake (LH and RH)
(2) Install the the brake case
(3)join the rear axle and rear transmission

Note:
Make sure that the diff-lock shifter is fitted into the groove in the dif-lock metal
(4) Reinstall the other removed parts.
(5) Mount the rear wheel.
(4) Refill the transmission with oil up to the specified level
-Level up to fill the oil can be sought from the rear side of rear transmission case(Window)

7.SEPARATION OF THE REAR TRANSMISSION AND MID PTO GEARS

Parts which can be inspected during This operation
-MID PTO gears.

Inspection and service of the rear transmission should be performed following the instructions in the paragraph : 5 SEPARATION OF THE REAR TRANSMISSION AND SPACER TRANSMISSION

1)Removal

(1) Remove the operator's seat.

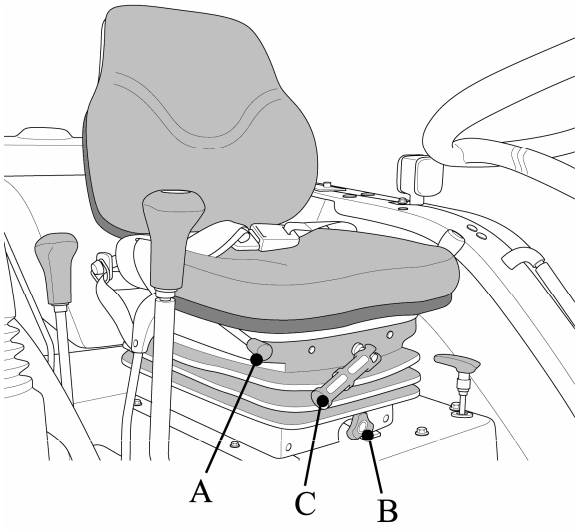


FIG.2-56 operator's seat

(2) Remove the position lever
(3) Remove the lever guide(RH)
(4) When the tractor is equipped with an optional remote control valve,remove the remote control lever and related parts from the bracket.
(5) Remove the back panel
(6) Remove the tank cover
(7) Remove the wiring for the rear combination lamps and trailer socket coupler.
(8) Drain the fuel of fuel tank.
(9) Remove the fuel tank and tank stay bracket .
(10) Detach the delivery pipe from the cylinder case.
(12) Remove the slow-return check valve along with the shaft.
(13) Remove the 3-point lift link and related parts from the lift arm.
(14) Remove the MID PTO case tightening bolts.
(15) Detach the MID PTO case assembly from the rear transmission.

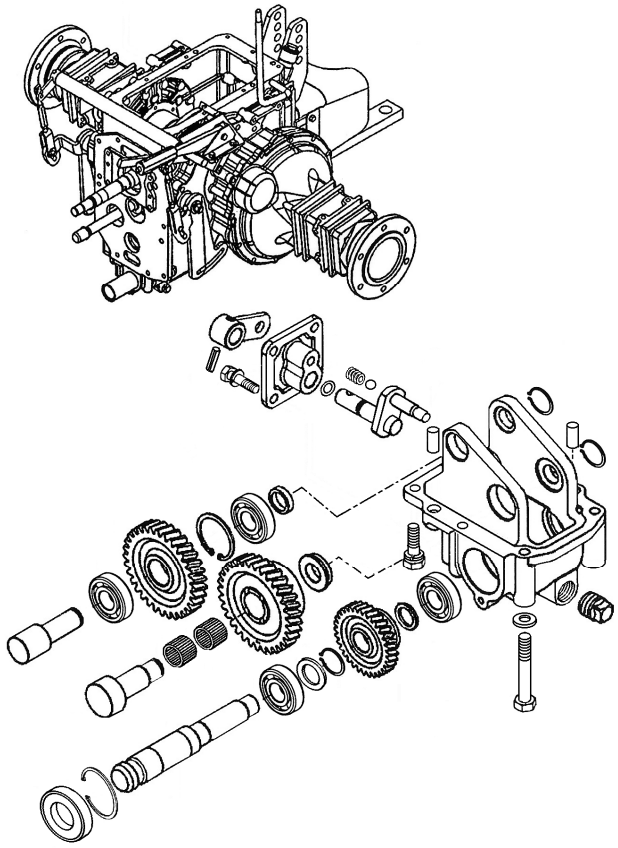


FIG.2-57 MID PTO case

2) Installation

Reassemble the reverse order of disassemble.

(1) Tighten the MID PTO case on the rear transmission case to the specified torque.

Tightening torque	2.45~3.43 Kgf.m

(2) After reassembly, make sure that the system functions properly.

8.SEPARATION OF THE REAR TRANSMISSION AND CYLINDER CASE

Parts which can be inspected during This operation
- Control valve
- Control linkage
- Piston and lift crank linkage
- PTO change gears.

Inspection and service of the rear transmission should be performed following the instructions in the paragraph : **5 SEPARATION OF THE REAR TRANSMISSION AND SPACER TRANSMISSION**

1)Removal
(1) Remove the operator's seat.

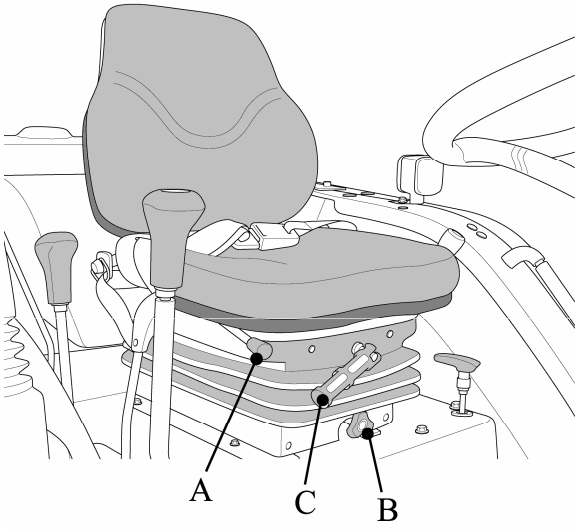


FIG.2-58 operator's seat

(2) Remove the position lever
(3) Remove the lever guide(RH)
(4) When the tractor is equipped with an optional remote control valve,remove the remote control lever and related parts from the bracket.
(5) Remove the back panel
(6) Remove the tank cover
(7) Remove the wiring for the rear combination lamps and trailer socket coupler.
(8) Drain the fuel of fuel tank.
(9) Remove the fuel tank and tank stay bracket .
(10) Detach the delivery pipe from the cylinder case.
(12) Remove the slow-return check valve along with the shaft.
(13) Remove the 3-point lift link and related parts from the lift arm.
(14) Remove the Cylinder case tightening bolts.
(15) Detach the cylinder case assembly from the rear transmission

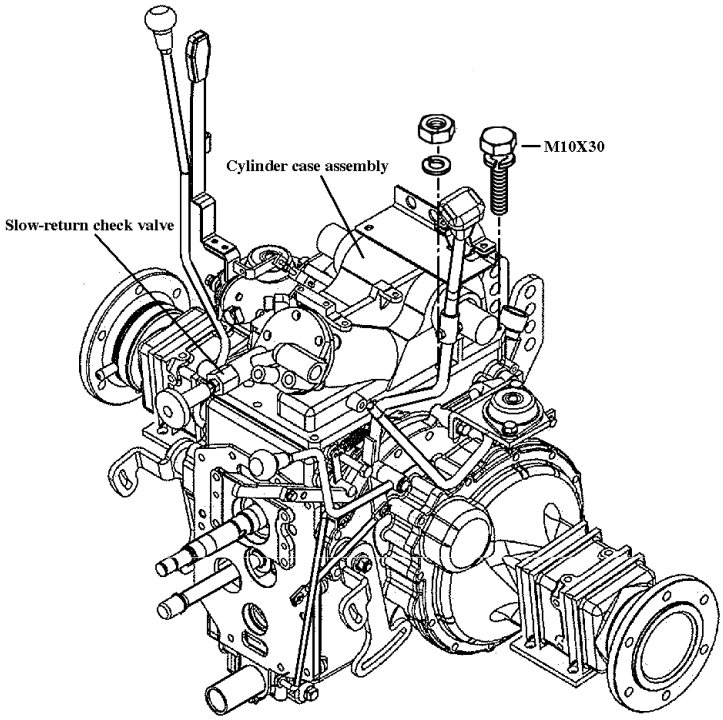


FIG.2-59 cylinder case

2) Installation
Reassemble the reverse order of disassemble.
(1) Tighten the cylinder case on the rear transmission case to the specified torque.

Tightening torque	5.4~6.87 Kgf.m (39.8~50.6lb.fts)

(2) After reassembly, make sure that the system functions properly.

Chapter 3
ENGINE ACCESSORIES

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Chapter 3.Engine accessories

SECTION 1. RADIATOR

1.General description

The pressure cooling system includes mainly the radiator,water pump,multi-blade fan, and

the thermostat.During the warm-up period,the thermostat remains closed and coolant is directed through by-pass to the suction side of the water pump.

Coolant then circulates through the cylinder block and water pump only to provide a uniform and fast warm-up period. Once the engine has reached operating temperature,the thermostat opens and coolant is pumped from the bottom of the radiator via the lower hose into the cylinder block. Here it circulates through the block and around the cylinders.

From the cylinder block,coolant is directed through the cylinder head and into the thermostat housing.With the thermostat open,coolant passes through the housing and upper radiator hose into the top of the radiator where it is circulated to dissipate heat.

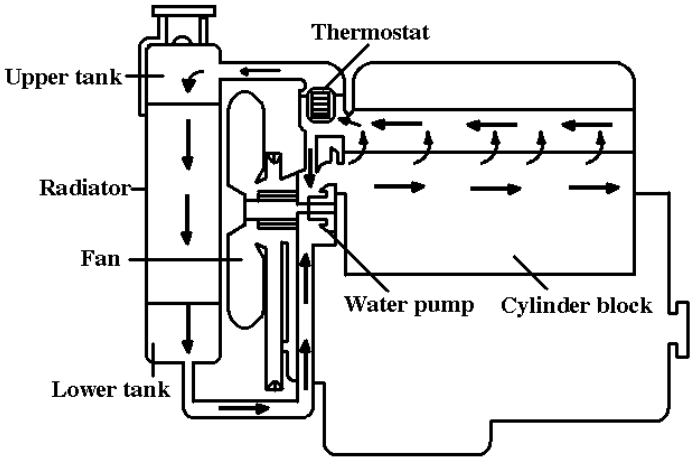


FIG.3-1

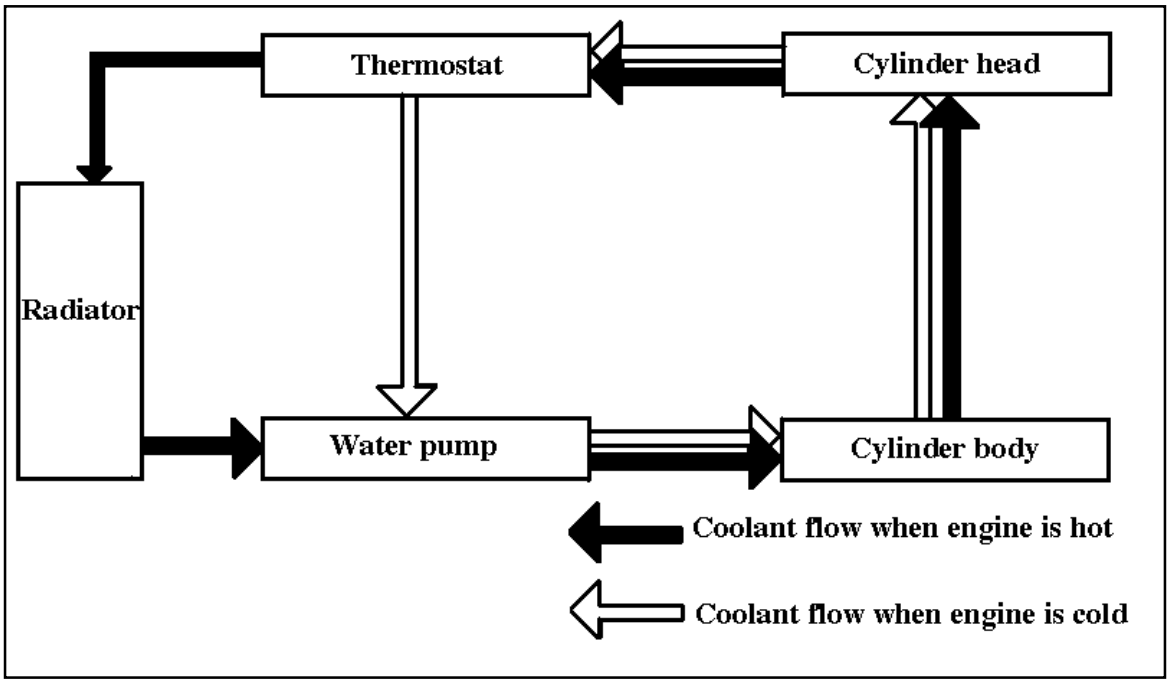
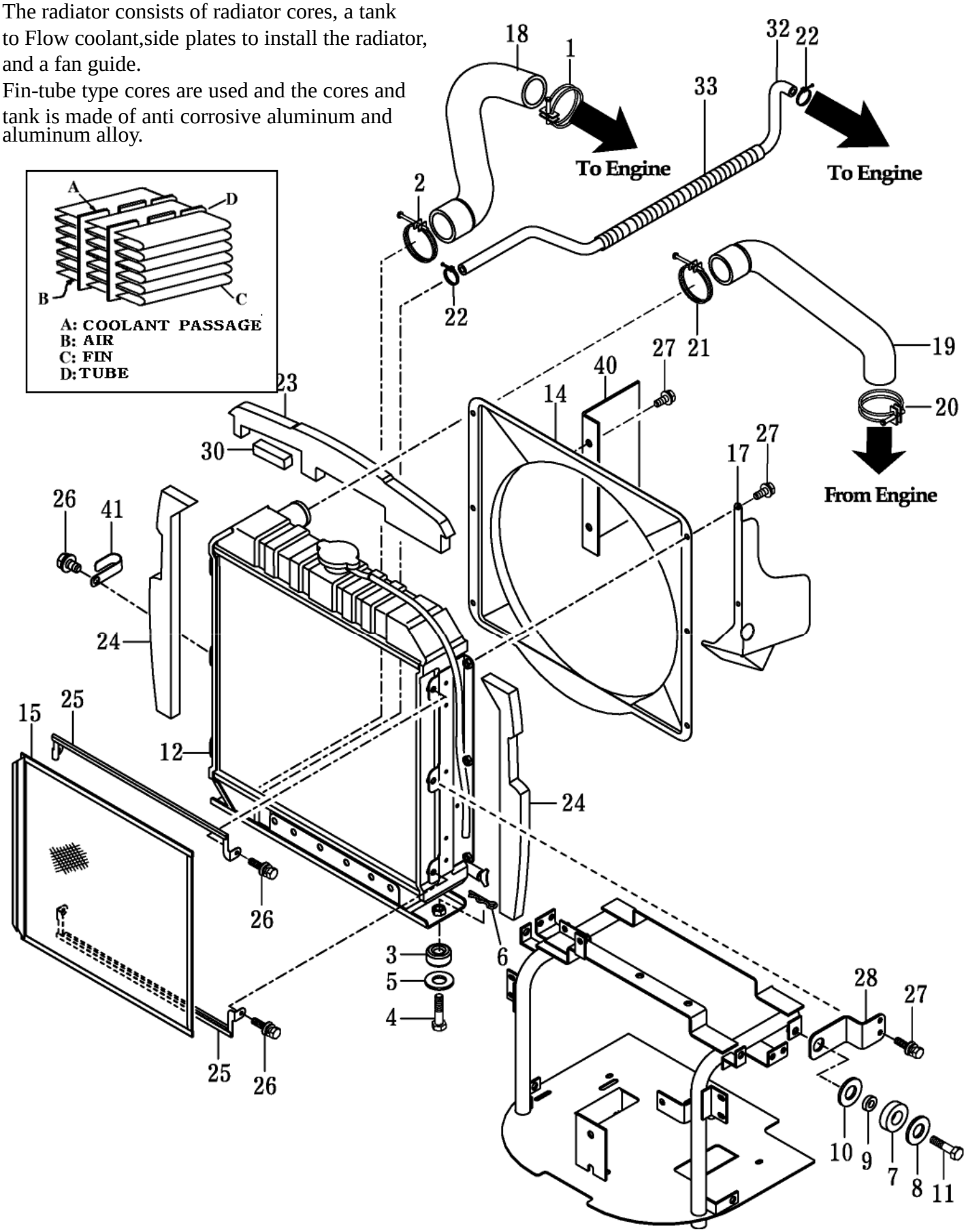


FIG.3-2

2. Radiator

The radiator consists of radiator cores, a tank to Flow coolant,side plates to install the radiator, and a fan guide.

Fin-tube type cores are used and the cores and tank is made of anti corrosive aluminum and aluminum alloy.



3. SPECIFICATIONS

Description	T303HST/T353HST
Radiator core type	Flat water tube with corrugate fins
Core train number	4 trains
Radiator fin pitch	4.2 mm
Thermal radiator area	9.3044㎡
Pressure valve opening pressure	0.9±0.15Kgf/ ㎠
Coolant capacity	7 ℓ(contains in cylinder block)
Test pressure	0.9±0.15 Kgf/㎠

4. REMOVAL OF THE RADIATOR

1) Release the clamp and remove the upper hose.

2) Release the clamp and remove the lower hose.

3) Release the hose clamp and remove the water drain hose.

Note:
- Refer to the paragraph"SEPARATION OF THE ENGINE AND THE FRONT AXLE BRACKET in chapter 2 for operation up to this step.

-When removing the radiator,take care not to damage the radiator cores and oil cooler.

5. INSPECTION OF EACH PART

(1) Inspection for radiator water leaks.

Water leaks are liable to occur at the fitting portion between the upper tank and the core section or between the lower tank and the core section.
If any water leak should occur there,repair the leak by soldering.Besides making a visual check,a more complete inspection should be accomplished as follows:

a. Leak test with compressed air.

Place the radiator as shown in the figure. Close the openings for water inlet and with something like a rubber plug and apply compressed air (1㎏f/㎠ or 14.2psi) through the drain pipe into the radiator.

Excessively compressed air may damage the cores, so perform the air delivery carefully,watching the pressure gauge. Water leaks are inspected by watching for rising air bubbles.

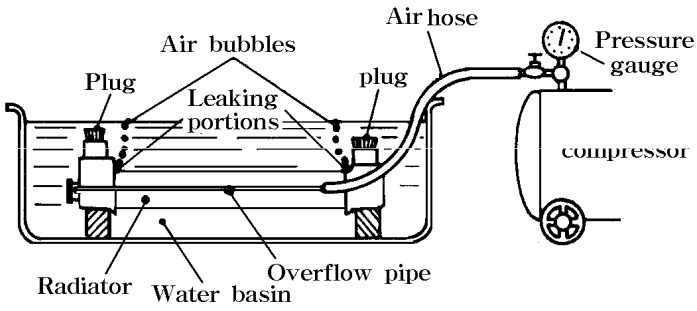


FIG.3-4

b.Leak test with a radiator cap tester

With the inlet and outlet pipes plugged up and the radiator filled with water,replace radiator cap with a radiator cap tester as shown in the figure.
Pump up the pressure in the radiator to the specified value and check to see if there are any leaks in the radiator.
When the radiator is water-tight,the pressure indicated on the pressure gauge does not increase,but if there are leaks,the pressure decreases.This tester is also applicable for leak tests for the whole cooling system,not only for the radiator.The test method is the same as mentioned above.

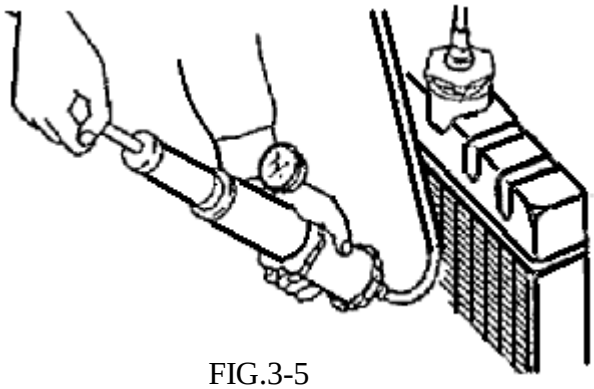


FIG.3-5

Testing Pressure	1.8Kgf/ /㎠

2) Inspection for radiator clogging

To inspect the radiator cores to see if they are clogged with fur or rust,remove the radiator cap and check for transparency of the coolant,and for rust or fur formation around the radiator throat inside the radiator.

If some rust or fur has formed or the coolant transparency is very poor,the radiator should be cleaned.

a. Cleaning the radiator inside.

-Place the radiator upside down and supply pressurized water from a faucet to the lower tank, draining through the upper tank,as shown in the figure to wash out accumulated deposits.

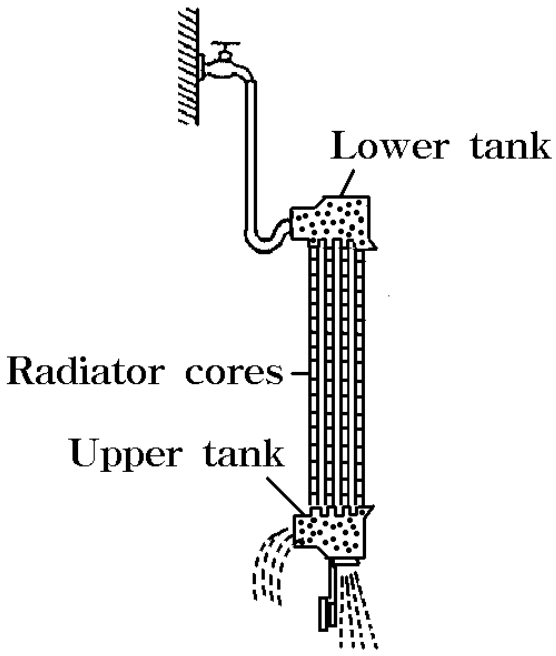


FIG.3-6

-Clean with a detergent
When cleaning the radiator with a detergent, follow the instructions given by its manufacturer. Different detergents have different characteristics.

b. Cleaning the radiator exterior

- Cleaning the net (wire mesh)
After the tractor has been operated in dusty conditions,check the net daily and clean it if necessary.

-Cleaning the radiator cores

Clean the radiator cores by applying water spray or compressed air so as to for a right angle with the radiator cores,moving water application in parallel.

Note:
When cleaning the radiator cores with pressurized water,be sure to apply it at a right angle to the cores. Slanted application might deform their cooling fins.

3) Visual inspection of the exterior parts

When the radiator exterior is corroded,cracked,or badly damaged,replace the radiator.Also replace damaged or fatigued water hoses.
Retighten loose hose clamps securely if water is leaking through the hose clamps securely ,or replace them if necessary.

4) Inspection of the radiator cap.

Check the radiator cap to see if it functions normally,using a radiator cap tester as following.

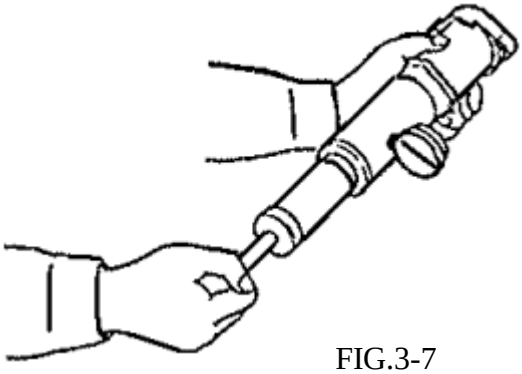


FIG.3-7

Pressure valve Opening pressure	0.9 Kgf/ ㎠ (12.79 psi)
Vacuum valve Opening pressure	0.04-0.05 Kgf/ ㎠ (0.57-0.71psi)

-Function test:

The pressure type radiator cap has a pressure valve and a vacuum as shown in the figure.

Both valves are held against there seats by springs while the pressure in the cooling system remains within a specified range,thus keeping the cooling system air-tight.

When the pressure in the radiator rises higher than the specified valves,it overcomes the force of the pressure valve spring and open the pressure valve to release excess pressure through the overflow pipe as shown in the figure.

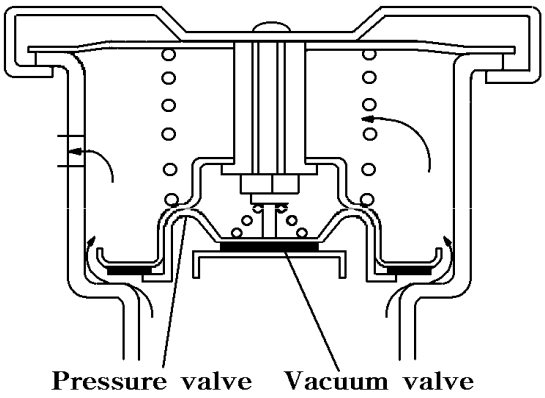


FIG.3-8

When the coolant temperature falls enough to cause the vapor to condense in the cooling system and decrease the coolant volume,the radiator pressure becomes negative.When this occurs,the vacuum valve opens to let outside air into the radiator as shown in the figure,

thus preventing the radiator from being deformed.

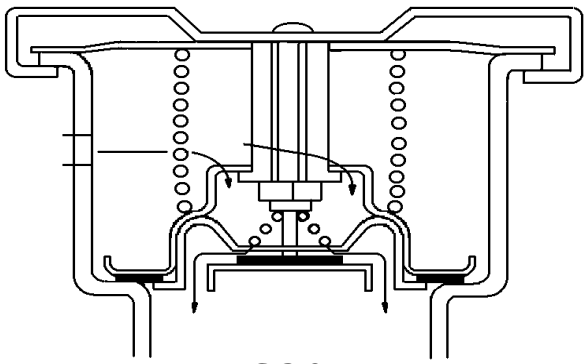


FIG.3-9

6. RADIATOR REASSEMBLY

Reassemble the radiator in the reverse order of disassembly.

Note:

- The rubber hoses should be clamped securely and must not interfere with the cooling fan.
- The radiator cores must not interfere with the cooling fan.

7. DAILY INSPECTION

1) Coolant level inspection and coolant replacement

When the radiator is hot after operation,be sure to wait until the coolant cools down sufficiently before removing the radiator cap.

If this is not done,heated vapor might burst out and cause burns.Use fresh water from a faucet as the coolant. When the coolant is replenished or changed,let the engine idle for a while for the coolant to circulate sufficiently in the cooling system and replenish if necessary after stopping the engine.

2)Antifreeze

When The weather is cold,use an antifreeze to prevent the engine from freezing.The freezing point differs according to the mixture ration of water and antifreeze.Therefore,prepare an antifreeze solution which will have a freezing point 5℃ lower than the estimated lowest atmospheric temperature in your environment.

Precaution for filling antifreeze.

- The radiator interior should be washed clean ahead of time.
- As concerns of mixing ratio of an antifreeze, follow its manufacture's instructions.
- Antifreeze should be blended well with water before filling.
- When the coolant level is lowered due to evaporation,maintain the level by adding water, not by using an antifreeze solution.
- When the coolant level is lowered due to leaks, maintain the level by adding an antifreeze solution of the same mixing ratio.
- As antifreeze corrodes point,take care not to spill it on painted parts.

-The tractor is filled with a permanent type antifreeze (Mobile Long Life Coolant) when shipping(mixing ratio:50%)

8. TROUBLE SHOOTING

TABLE 3-1

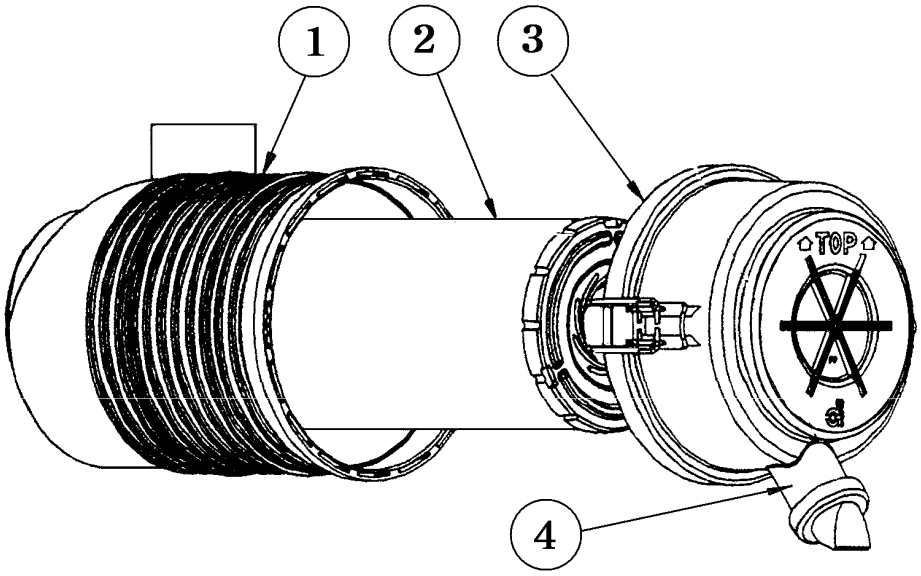
Problems	Causes	Countermeasures
1) Overheating	(1) Low coolant level	(1)Replenish coolant and inspect water leaks.
	(2) Fatigued pressure valve spring	(2)Replace radiator cap.
	(3) Loose or broken fan belt	(3)Adjust belt tension or replace.
	(4) Oily fan belt	(4)Replace.
	(5) Poor thermostat	(5)Replace.
	(6) Poor water pump or water leaks	(6)Repair or replace.
	(7) Clogged water passages	(7)Clean radiator and water passages.
	(8) Improper injection timing	(8) Adjust injection timing.
	(9) Clogged air ways	(9) Clean radiator exterior.
	(10) Fuel gas enters water jacket due to broken cylinder gasket	(10) Inspect cylinder head and replace cylinder gasket
2) Overcooling	(1) Poor thermostat	(1)Replace
	(2) Excessive low atmospheric temperature	(2) Decrease radiator working area by radiator masking.
3)Lose of coolant	(1) Leaking radiator	(1)Repair or replace
	(2) Loosely clamped or broken water hose	(2)Retighten or replace
	(3) Fatigued pressure valve spring	(3)Replace radiator cap
	(4) Leaking water pump	(4)Repair or replace
	(5) Water leakage through cylinder head gasket	(5) Inspect cylinder head and Replace gasket
	(6) Cracked cylinder head or body	(6)Replace
4) Noisy cooling fan	(1) Poor water pump bearing	(1)Replace
	(2) Loose or bent fan	(2)Retighten or replace
	(3) Unbalanced fan	(3)Replace.
	(4) Poor fan belt	(4)Replace.

SECTION 2. AIR CLEANING SYSTEM

1.GENERAL DESCRIPTION

Unfiltered air contains many particles harmful to the engine such as dust ,sand,or other foreign matter. When such foreign matter have entered in to the engine,They have mixed into the lubricant and promote wear of lubrication parts in addition to damaging the piston cylinders.To eliminate these harmful particles,an air cleaner has been installed.The air cleaner Which is installed on the T series tractor is a dry,cyclone type and is constructed as shown in the figure.

Under the influence of suction generated by the engine,unfiltered air flows through air inlet tube and is forced into a high-speed centrifugal motion.By this circulating action most of the dust and dirt particles are separated from the air and collected in the dust unloading valve(4).The remaining dust is removed as the air flows through the paper element(2) before being drawn into the engine.



① Body ② Paper element outer ③ Cover assy ④ Dust unloading valve

FIG.3-10 Air Cleaner

2.ELEMENT AIR CLEANER

(1) SPECIFICATIONS.

Model	T303HST/T353HST
Type	Dry, paper element filtering type
Rated intake air volume(㎥/min .(cu.ft/min)	4.25(150)
Air venting resistance (㎜Aq)	120 or less
Cyclone efficiency (%)	45 or over
Total filtering efficiency(%)	99.9 or over
Dust holding capacity (gr)	700
Filtering area (㎡)(sq.in)	1.89±4%
Filter material	FPG 057512
Temperature	-30~80˚C

(2) DISASSEMBLY

1) Element removal

Remove the wing bolt which clamps the paper element and take out the element.

1.Air cleaner Sub assembly
1-01.Body assy
1-02.Body
1-03.Cover
1-04 Cover assy
2.Bracket comp ,guide
3.Hose,air inlet
4.Hose,air outlet
5.Clip,64
6.clip,60
7.Bolt
8.Plate ,stay

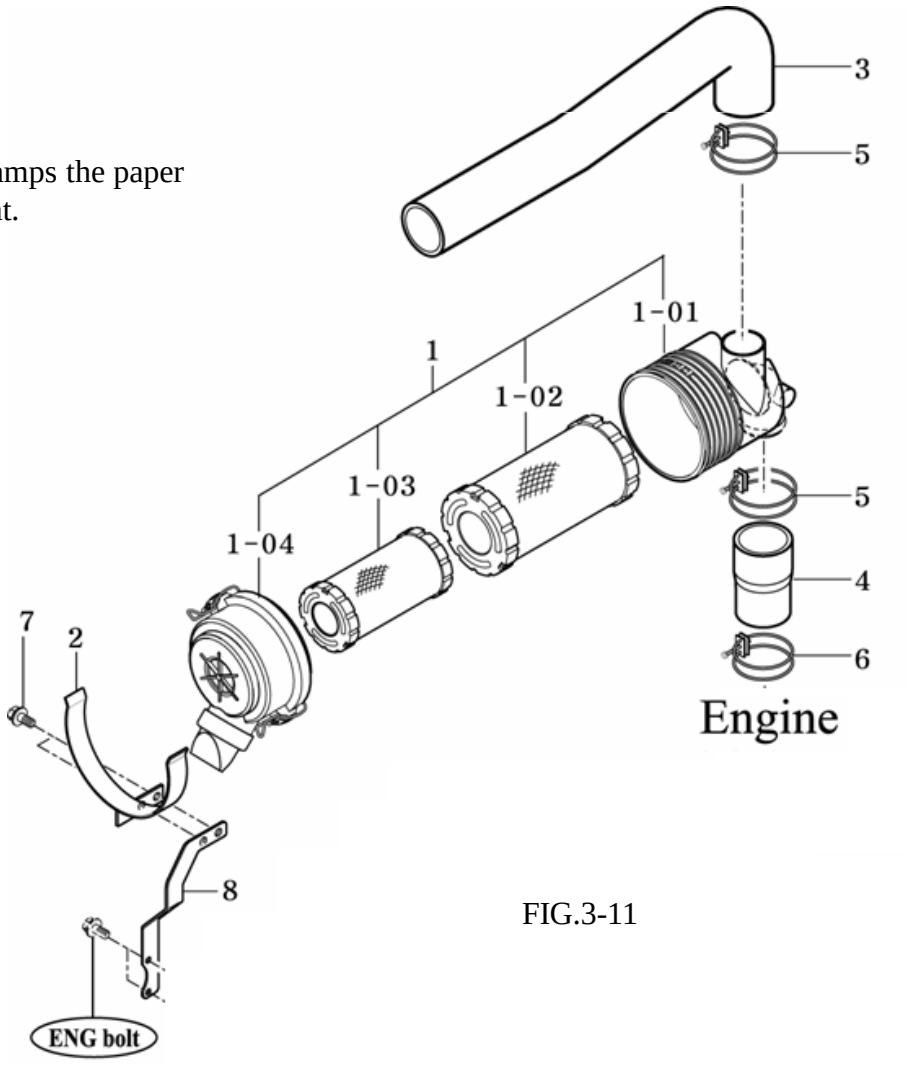


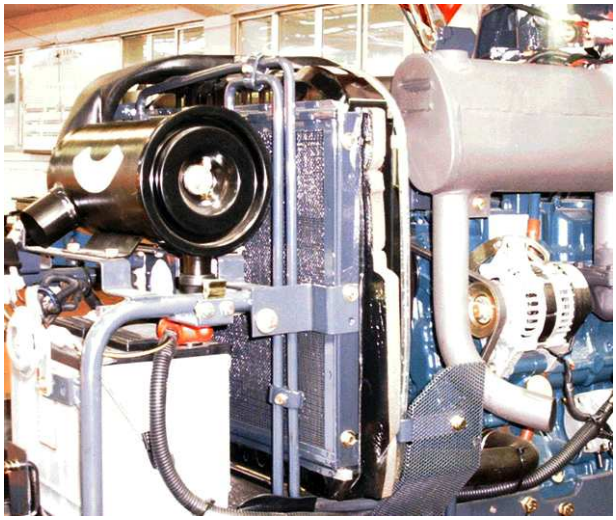
FIG.3-11

3. INSPECTION OF EACH PART

1) Inspection of the cleaner body

(1) Check the cleaner exterior for cracks, deformation,or damage and repair or replace if necessary.

(2) Check each packing for fatigue or damage and replace if necessary.



2) Inspection of rubber hoses

Check the rubber hoses for fatigue or damage and replace if necessary.

3) Inspection of the paper element to check the element for damage,Dry it sufficiently after washing and put an electric bulb in to the element and look for damage.

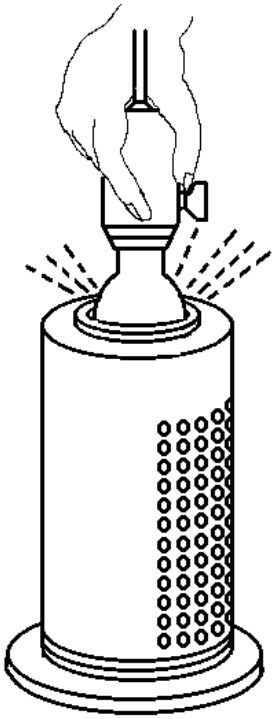


FIG.3-12 Element check

Note:

Especially note the glue portions of the paper and metal parts.

4. CLEANING THE AIR CLEANER

Clean the air cleaner after 100 hours of operation or less depending on conditions in the following manner.

1) When the air cleaner is cleaned or the element is replaced,dust accumulated inside the air cleaner body should be removed with a cloth.As inhaled dust causes engine wear,remove a dust accumulated inside the inlet pipe,the rubber hose which connects in the inlet pipe and the air cleaner,the inlet manifold,and inlet port.

(1)When accumulated dust is dry.

-When removing the dust in the element,hold the element by a hand and pat the side wall with other hand. Never hit the element against a stone or a concrete wall because that might cause its side wall to peel off.

-apply compressed air from inside of the element to blow dust off while turning the element by hand.

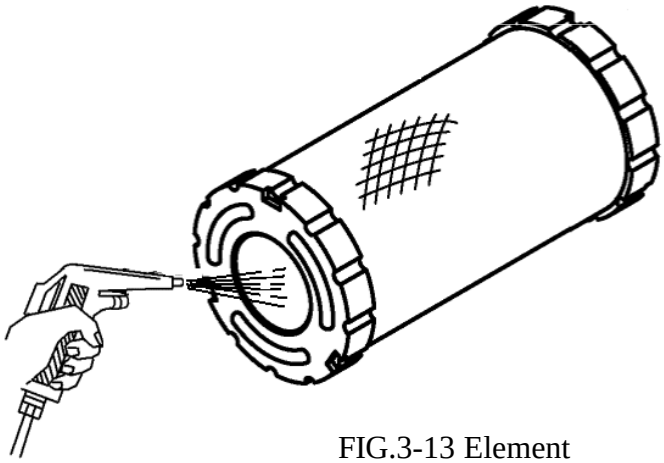


FIG.3-13 Element

Note:

The compressed air to be applied should not have a pressure of more than 7㎏/㎠(99.6psi)

Maintain sufficient distance between the air gun and the element.

(2)When accumulated dust is oily.

-Use a solution of TC 101 element detergent or the quality household neutral detergent. Leave the element in the solution for approximately 30 minutes and then wash it by dipping it in and out of the solution.

-After soaking,rise it in fresh water.

-Let it in a shaded and well ventilated place. Forced drying by heat or compressed air is prohibited.

Note:
Water applied to rinse the element should not have a pressure of more than 2.8kgf/㎠ (39.8psi).
An element which has been washed 5 times must be replaced with a new one.

5.ELEMENT INSTALLATION
Install the element in the reverse order of disassembly,but follow these instructions.

1) Each tightening clamp must be secured and care must be taken not to miss the packing and washers.
2) Before installing the element,clean the rubber packing on the top of the element.

Note:
The clamp retaining the element should be tightened sufficiently so that it will not become loose during operation

CHAPTER 4
HST system

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SECTION 1. SPECIFICATIONS

General

Hydraulic Reservoir Capacity----------35ℓ (9.24 us gal)
Pump or motor Roller Bearing(From back plate to Top surface of bearing)-------
---------- 2.3 mm±0.2 mm(0.090 ±0.010 in)
Roller Bearing in Motor Housing(Recess From Top of Counter bore) ----------
---------- 2.0 mm±0.3 mm(0.078 ±0.015 in)
Spring pin in Back plate(From Back plate to Top surface of pin)---------- 4.4 mm(0.017 in)

HYDROSTATIC PUMP

Manufacturer----------EATON
Type ----------piston pump
Model----------77122RAA
Displacement(Variable)(maximum/rev0---------- 40.6㎤/rev(2.48 in³/rev)
Displacement(Engine at 2700rpm)---------- 109.7L/min(28.99 gpm)
Pressure relief Valve setting ---------- 41368 ㎪(6000 psi)

HYDROSTATIC MOTOR

Manufacturer ----------EATON
Type----------Fixed displacement Axial piston Motor
Displacement (Fixed) ---------- 40.6㎤/rev(2.48 in³/rev)
Displacement(engine at 2700 rpm) ----------109.7L/min(28.99 gpm)

TORQUE SPECIFICATIONS

Pump to back plate mounting Cap Screws---------- 37-42 N.m(27-31 lb-ft)
Motor to Back plate mounting Cap Screws---------- 10-14 N.m(87-123 lb-in)
Forward and Reverse pressure Relief valve---------- 135-149 N.m(100-110 lb-ft)
Charge pressure Relief Valve---------- 37-47 N.m(27-30 lb-ft)
Charge pressure Diagnostic port plug---------- 13-16 N.m(115-142 lb-in)
Pump side Passage Plugs on back plate---------- 13-16 N.m(115-142 lb-in)
Motor side Passage Plugs on back plate---------- 28-33 N.m(21-24 lb-ft)
Transmission to tunnel Mounting Screws---------- 126-154 N.m(95-115 lb-ft)
Tunnel to flywheel housing----------126-154 N.m(95-115 lb-ft)
Tunnel to rear transmission housing----------126-154 N.m(95-115 lb-ft)
SCV pressure Tube to pump---------- 55-79 N.m(40-59 lb-ft)
SCV pressure Tube to SCV---------- 55-79 N.m(40-59 lb-ft)
SCV Work port Tubes to SCV----------40-57 N.m(30-43 lb-ft)
Charge pressure Tubes to transmission Adapters---------- 55-79 N.m(40-59 lb-ft)
Cam plate bearing Caps Cap screw---------- 37-42 N.m(27-31 lb-ft)
Tunnel Section to Differential housing Cap Screws----------126-154 N.m(95-115 lb-ft)
Tunnel Section to Clutch Housing Cap Screws---------- 126-154 N.m(95-115 lb-ft)

1.SPECIAL OR ESSENTIAL TOOLS.

Note; Order tools according to information given in the U.S SERVICE-GARD ™ Catalogue or in the European Microfiche Tool Catalogue(MTC)

Parts number	parts name
JT07335-1,2,3	Splitting Standard and Brackets
JT03344	2,000 Kpa(300 psi) Gauge
JT03362	68947KPa (10,000 psi) Gauge
JT03364	Hose with quick coupler
JT03017	Hose with quick coupler
JT03240	7/16-20M 37°X7/17-20 F 37 ° Elbow
JT03264	Quick coupler F7/16-20 F 37 ° Adaptor
JT05480	Quick coupler MXM14-1.5 ORB Adapter

2.OTHER MATERIALS

Number U.S.A/Canadian	Name	Use
Petroleum Grease	John Deere Clean and cure primer	pump and Motor Reassembly
TY16021	John Deere High Flex Form-in-place Gasket	Hydrostatic Transmission to Tunnel Seal
TY15934	John Deere General Purpose Gasket Dressing	Sealing Gasket and Hoses

SECTION 2. COMPONENT LOCATION

1.Hydraulic Hoses and lines.

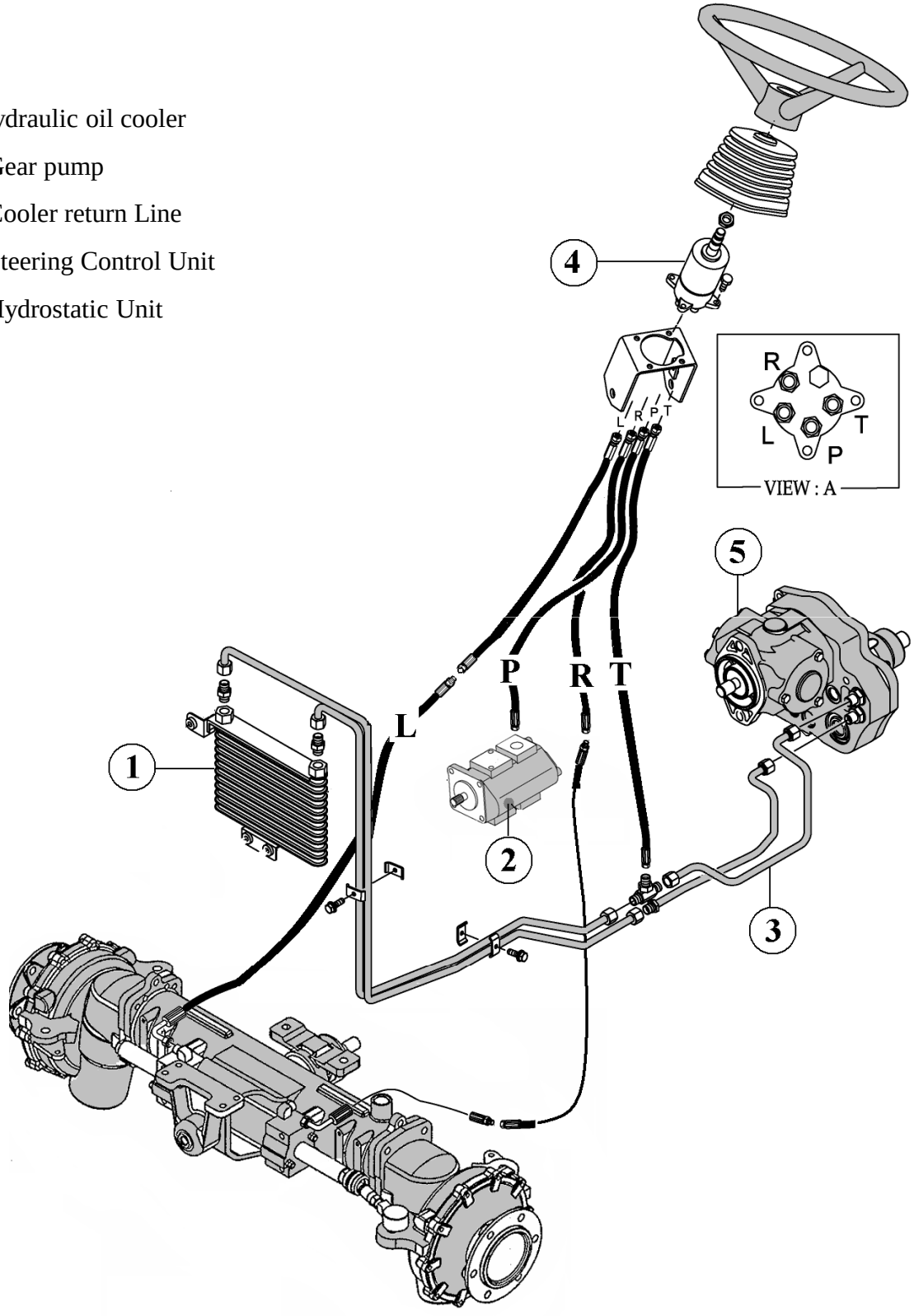
1.hydraulic oil cooler

2. Gear pump

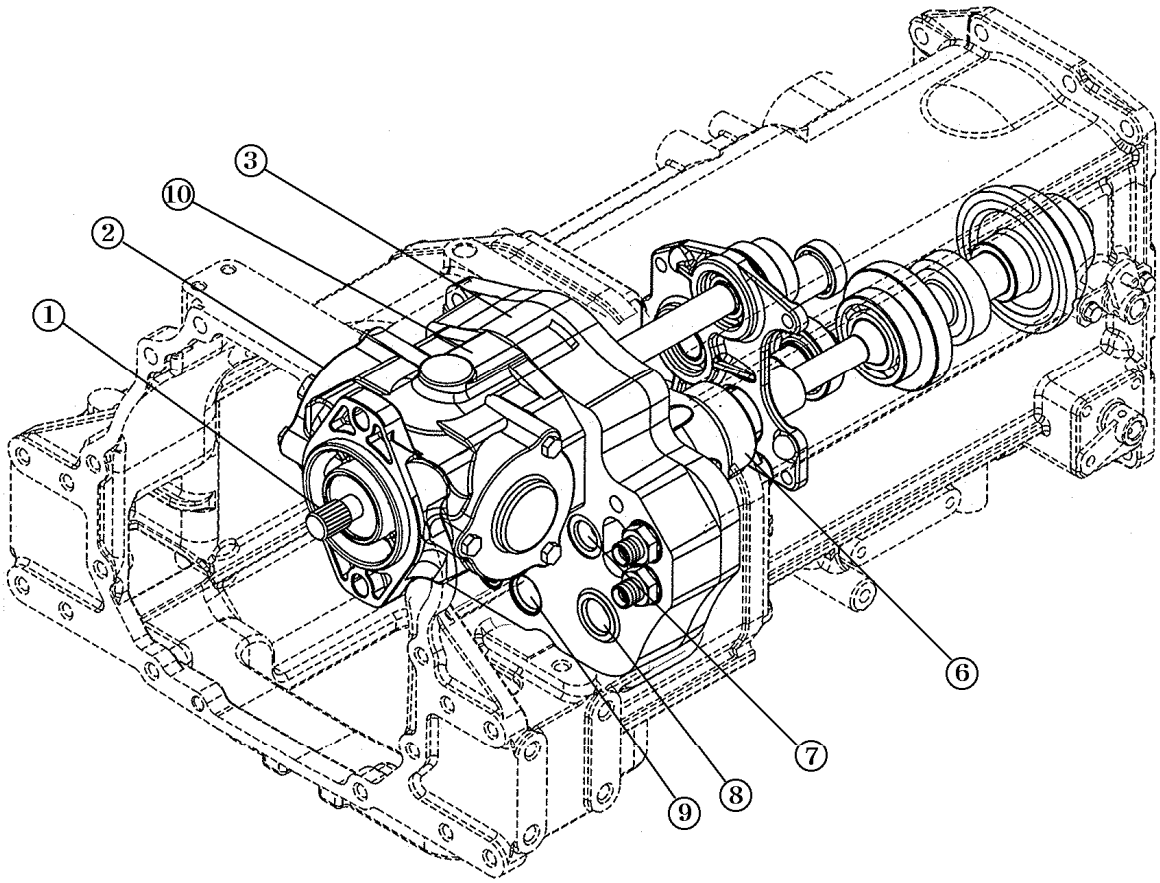
3. Cooler return Line

4. Steering Control Unit

5. Hydrostatic Unit

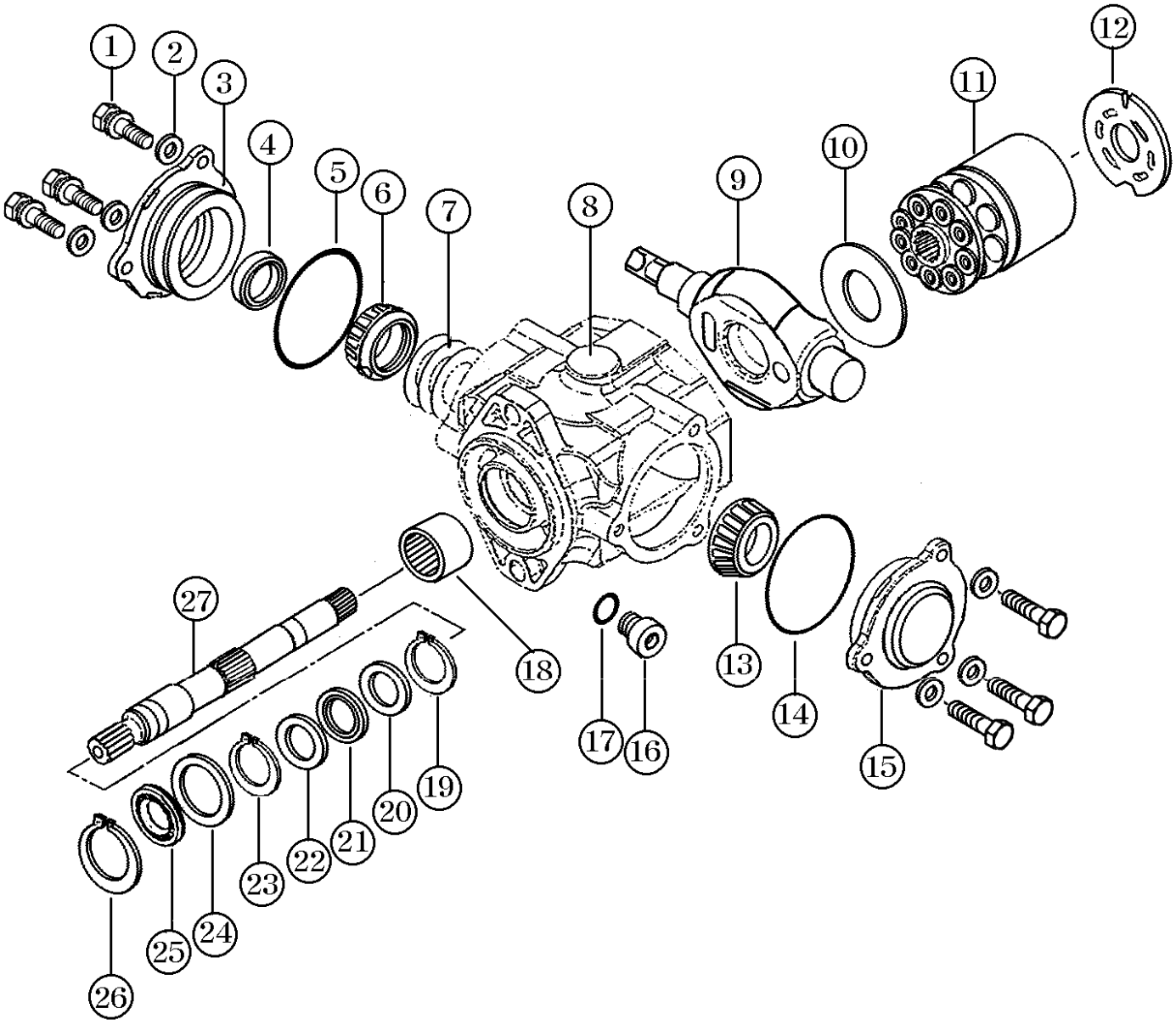


2.Hydrostatic transmission



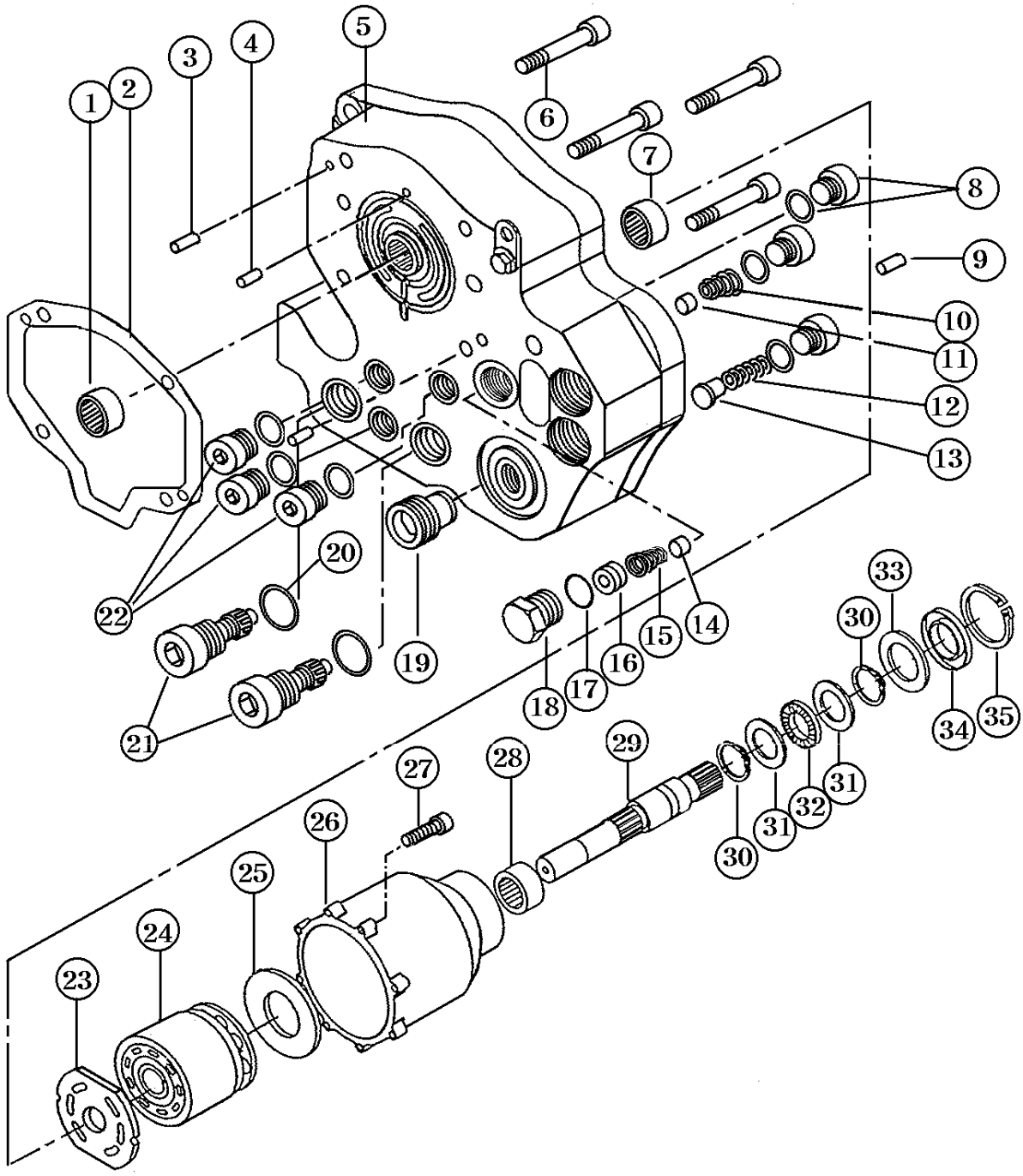
1. Input shaft From engine
2. Control Lever
3. Back Plate
4.Hydrostatic motor
7. Charge pressure relief Valve
8. Filter mount port
9. For,&Rev.Relief valves
10. Hydrostatic pump

3. Transmission main pump case



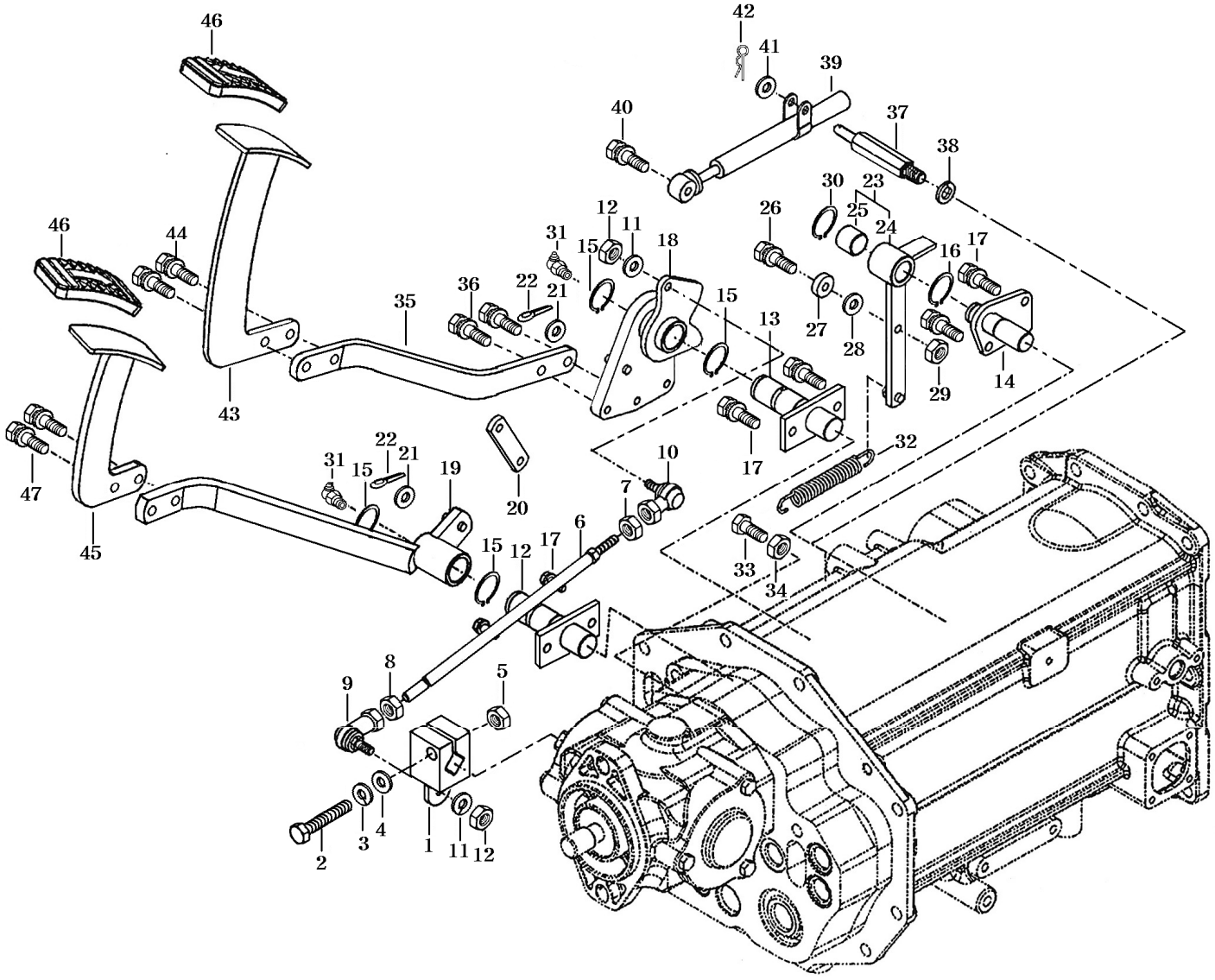
1. Cap screws (6) 2. Washers(6) 3. Cover 4. Seal 5. O-ring 6. Bearing
7. Shims 8. Housing 9. Cam plate 10. Cam washer 11. Rotating Assembly
12.Valve plate 13. Bearing(4) 14. O-ring 15. Cover 16. Plug 17. O-ring
18. Bearing 19. Snap ring 20. Thrust Washer 21. Thrust Bearing
22. Thrust Washer 23. Snap ring 24. Seal Washer 25. Seal
26. Snap ring 27. Shaft

4. Transmission back plate and motor



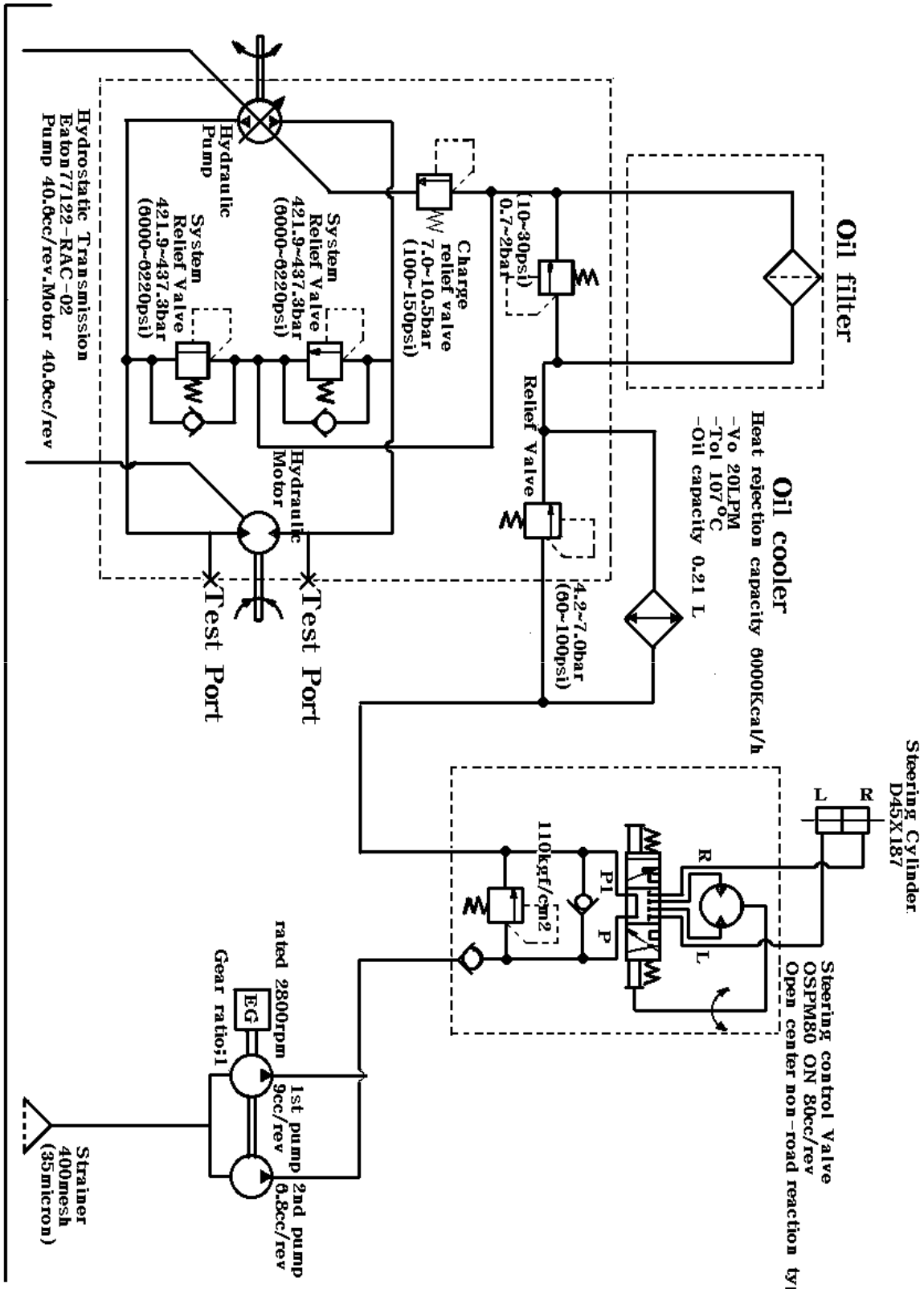
1.Bearing 2.Gasket 3. Pin 4. Pin 5.back plate 6. Cap screw 7.Bearing
8.plug and O-ring 10.Spring 11. Poppet 12.Spring 13. Plunger 14.poppet
15.Spring 16.Shims 17. O-ring 18.Plug 19.Filter head 20. O-ring
21.Relief valves,Forward and reverse 22. Plugs 23. Valve plate 24. Rotating assembly
25. Cam washer 26.Motor housing 27. Cap screw 28.Bearing 29.Shaft
30.Snap ring(2) 31.Thrust Washer 32.Thrust bearing 33. Seal washer
35.Snap ring

5.Hydrostatic control linkage

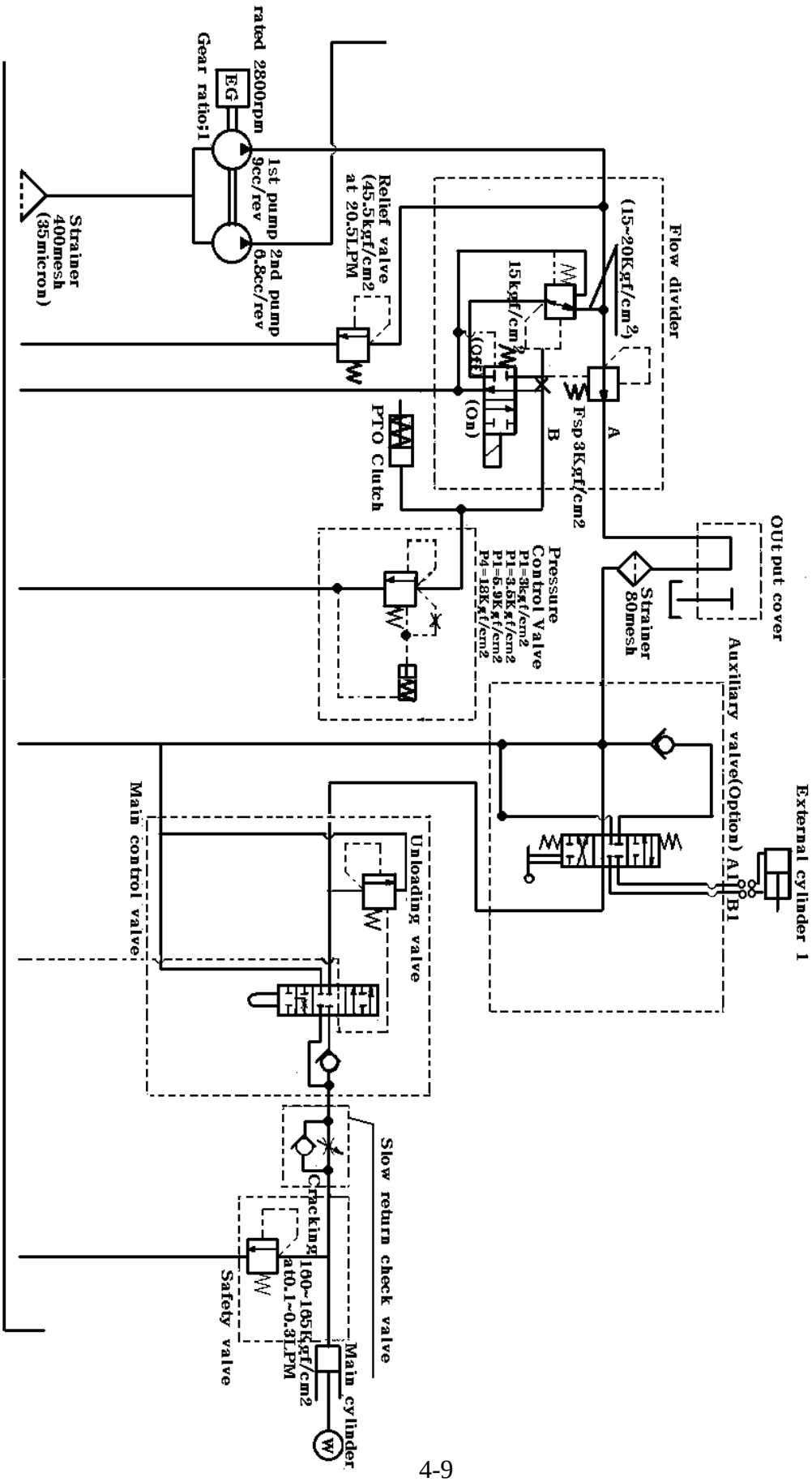


1.Holder comp
2.Bolt
3.Washer spring
4.Washer plain
5.Nut
6.Rod comp
7.Nut
8.Nut
9.Elbow,LH
10.Elbow,RH
11.Washer spring
12.Nut
13.Pin
14.Pin
15.Snap ring
16.Snap ring
17.bolt
18.Arm comp
19.Arm comp
20.Plate reverse
21.Washer plain
22.pin,split
23.Arm,cam
24.Arm,cam
25.Bush(20X23X20)
26.Bolt
27.Bearing ball
28.Washer plain
29.Nut
30.Snap ring
31.Nipple
32.Spring return
33.Bolt
34.Nut
35.plate,forward
36.Bolt
37.pin,oil damper
38.Washer spring
39.Damper oil
40.Bolt
41.Washer plain
42.Pin,snap
43.pedal comp(forward)
44.Bolt
45.Pedal comp(Reverse)
46.Pad
47.Bolt

6-1. Hydrostatic system schematic



6-2. Hydrostatic system schematic



SECTION 3. TROUBLESHOOTING

Problem or symptom / Check or Solution	Wheels on machine will not rotate	Noisy pump or Motor	Sluggish response to changes in speed	Low power	Wheels rotate in one direction only	Tractor moves without pressing forward or reverse pedal	Tractor Does not Move when Forward or Reverse pedal are Pressed
Check flex plate coupling between engine and pump	•						
Hydraulic level low in transaxle	•		•	•			
Low charge pressure (see Tests and Adjustments Section)	•		•	•			
Main drive pressure relief valve stuck open(see Test & Adjustments section)		•	•	•	•		
Air in system(see"HYDRAULIC SYSTEM BLEED PROCEDURE" on page 20)		•	•	•			
Hydrostatic motor output pressure too low (see tests and Adjustments section)			•	•			
Internal pump or motor damage or excessive wear	•	•	•	•			
Parking brake engaged or malfunctioning	•	•					
Pump centering mechanism not properly adjusted			•		•	•	
Gear box malfunction (see gear power Train section)	•						
Servo valve malfunctioning	•		•		•		
Pedal neutral position Not properly Adjusted						•	
Hydrostatic Control linkage Worn out or Damaged			•		•	•	•

Test conditions:

- Operator in seat
- Key switch in RUN position

Test/Check point	Normal	If Not normal
1. Control pedals	Pedal should move freely	Check linkage from pedals to pump

Test conditions:

- Start engine and run at slow idle

Test/Check point	Normal	If Not normal
2. Directional pedals are in neutral position	Machine should not creep forward or backward	Adjust centering of pump control pedals
3.Move forwards or reverse pedal slowly from neutral to maximum travel speed position	Machine should accelerate smoothly forward or backwards.	Check fluid reservoir for proper fluid level. Check hydraulic tubing,and connections for leaks. Perform system flow and pressure checks to verify proper operation of charge pump and hydrostatic pump
4. Control pedal in full forward position	Machine should move forward	Check pedals and forward/reverse linkage for damage. Check forward drive pressure relief valve
5. Control pedal in full reverse position	Machine should move backward	Check pedals and forward/reverse linkage for damage. Check reverse drive pressure relief valve.

HYDROSTATIC SYSTEM

Function:

The hydrostatic system provides a means to transfer Power from the engine to the final final drive to the wheels.it also provides infinitely variable speed control,forward or reverse,by foot pedal operation.

Principles of Operation:

The hydrostatic system is a closed loop fluid power system that consist of a charge pump on the left front side of the engine.and an EATON piston pump/motor assembly, which is driven by a Flexible coupler Attached to the flywheel.

Fluid flow is controlled by by changing the angle of the cam plate. This angle is controlled by the operator through a mechanical linkage.Moving the respective directional pedal will move the position of the cam plate.

Moving the cam plate off center changes the distance
the pistons travel inside the piston bore of rotating assembly.The direction that the cam plate is rotated from center determines the direction of fluid Flow (forward or reverse).The number of degrees the cam plate is deflected.determines how much fluid will be displaced(speed)

The hydrostatic pump provides hydraulic fluid to the hydrostatic motor through the back plate.Hydraulic fluid in the power train circulates in a closed loop. Fluid leaves the hydrostatic motor and is returned to the hydrostatic pump,not the reservoir.Fluid that leaves this closed loop circuit,such as case drain, is replenished by fluid from the charge pump.

Charge pump

The charge pump is a gear type positive displacement pump mounted to the right front side of the engine.
This pump provides pressurized fluid to the SCU (Steering Control Unit). Return oil from the SCU is routed through the filter mounted to the front of the back plate, and then into the hydrostatic pump to provide replacement fluid to the hydrostatic pump.

Hydrostatic Motor

The hydrostatic motor is an EATON high torque axial piston motor.The motor is located on the rear of the back plate.The hydrostatic motor drives the input shaft for a three speed range gear transmission which transfers power to the wheels. (See Final Drive Section)

SECTION 6. TESTS AND ADJUSTMENT

1.HYDROSTATIC PEDAL AND NEUTRAL ADJUSTMENT

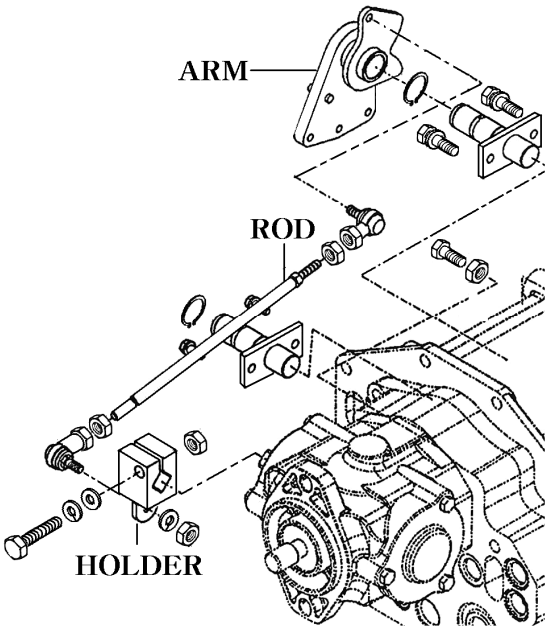
Reason:
To ensure that tractor does not move unless forward or reverse pedal is depressed.

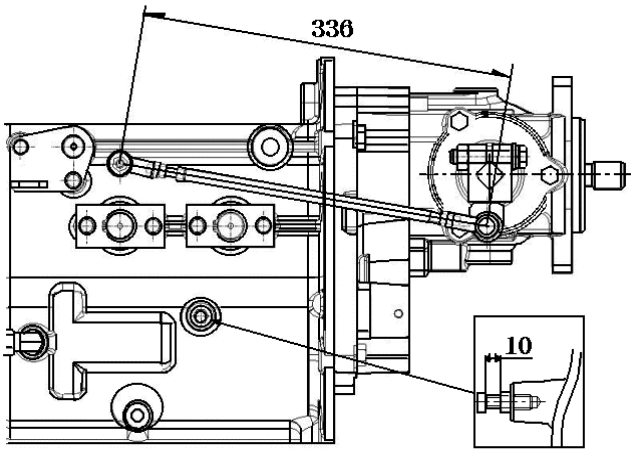
Procedure:
1.Operate the hydrostatic control pedals.They should return by themselves to the neutral position.If pedals do not operate properly,check pedals and linkage for damage or wear.
2.Start engine and run at low idle.
3.Place range shift lever in LOW gear. Tractor should not move.If tractor moves,note direction, and adjust neutral return lever as follows:

⚠ CAUTION

SEVERE INJURY OR DEATH CAN RESULT IF ENGINE IS NOT SHUT OFF WHEN PERFORMING NEUTRAL ADJUSTMENT

4.Shut engine OFF,engage park brake.
5. On the right side of the tractor,below the forward and reverse control pedals,locate the rod .The rod must be turned to perform the neutral adjustment





6. loosen the locking nut that holds the rod and the elbow to the transmission.
7.Using a wrench,Turn the rod to move the rod down to eliminate reverse,or up to eliminate forward movement .
8.Tighten the elbow and the nut .
9.start engine and run at low idle.
10.Place range shift lever in LOW gear.Tractor should not move.If tractor moves,repeat steps 4 through 11 until movement is eliminated.

2. HYDROSTATIC PUMP PRESSURE TEST

Reason:
To ensure that internal parts of the hydrostatic pump are not worn excessively,and the relief valves are operating properly.

Equipment:

JT03362	68947KPa (10,000 psi) Gauge
JT03364	Hose with quick coupler
JT03240	7/16-20M 37°X7/17-20 F 37 ° Elbow
JT03264	Quick coupler F7/16-20 F 37 ° Adaptor
JT05480	Quick coupler MXM14-1.5 ORB Adapter

IMPORTANT: Make sure that the hydraulic fluid is visible in sight glass.Insufficient hydraulic fluid could cause system to run dry and damage pump and motor.

IMPORTANT: Do not allow valves to relieve for more than 10 seconds or hydraulic oil may overheat.

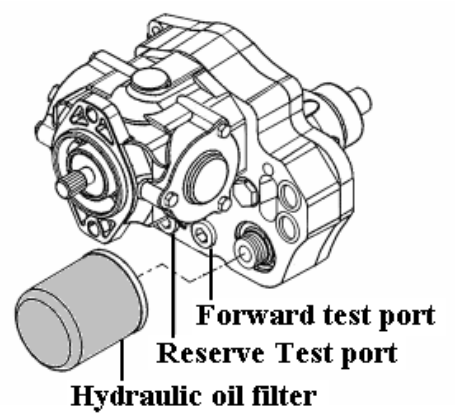
Procedure:

1.park tractor on a level surface
2.Turn key switch to OFF position.
3.Make sure 4WD lever is in unlocked 2WD position.

⚠ CAUTION

AVOID SUDDEN TRACTOR MOVEMENT.Tractor could move suddenly causing severe injure or damage to equipment during test procedure. Perform test in open area.keep all personnel away from front or rear of tractor

4.Start engine and run until hydraulic oil is warm.
5.Stop engine
6.Cycle all controls to relieve any pressure that may be in the hydraulic system



7.Locate test ports on hydrostatic transmission inside tunnel opening.
8.Remove test port plugs.
9.Install one JT05480 male quick coupler into each test port.
10.Attach JT03362 gauge and hose assembly as shown each test port adapter

11.Position gauges so they can be read from operator's seat.
12. Perform test from operators seat.Make sure park brake in engaged and press right and left brake pedals.Place range transmission shift lever in 3 (high) position.Start engine and run at full throttle.

⚠ CAUTION

If brake fail to prevent wheels from turning. STOP TEST IMMEDIATELY.Repair or adjust brakes are necessary before resuming test. (See brake section)

13.Slowly depress forward directional pedal and observe gauge.Gauge should slowly rise to approximately 41368 KPa±1378KPa (6000psi ±200psi)and relief valve will open with an audible squealing noise.
14.Repeat same procedure with reverse pedal.

Specifications:

-Pump pressure should reach approximately 41368 KPa±1378KPa (6000psi ±200psi) in either direction and then relieve.

Results:
-If pressure will not reach 41368 Kpa Maximum (6000psi) in either direction,check charge Pressure.(SEE ”CHARGE PUMP PRESSURE TEST on page 14)
-If charge pressure is good and hydrostatic pump pressure will not get up to relief pressure hydrostatic pump is worn or damaged.
-If pressure reaches 41368KPa(6000psi) in one direction and not the other,one of the relief valves is defective or the seat is leaking.

3.CHARGE PUMP PRESSURE TEST

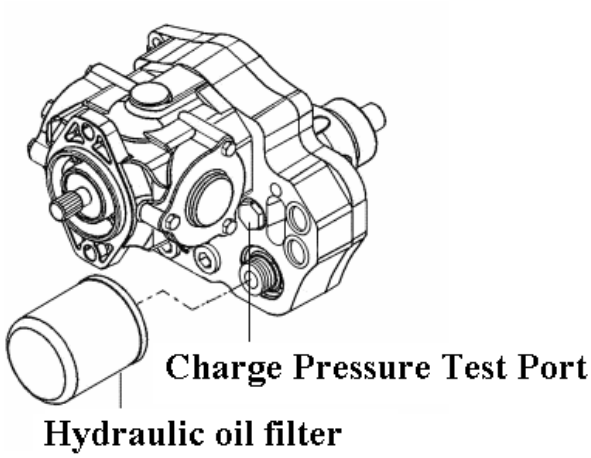
Reason:

To ensure that charge pump is operating at specified pressure to supply oil to hydrostatic pump.
Equipment:

JT03344	2,000 Kpa (300 psi) Gauge
JT03017	Hose with quick coupler
JT03240	7/16-20M 37°X7/17-20 F 37 ° Elbow
JT03264	Quick coupler F7/16-20 F 37 ° Adaptor
JT05480	Quick coupler MXM14-1.5 ORB Adapter

Procedure:
1.Park tractor on a level surface and set park brake.
2.Turn key switch to OFF position.
3.Shift transmission to NEUTRAL.

IMPORTANT:Make sure to relieve system pressure before loosening any system lines or hoses.
4. Cycle all controls to relieve any pressure that may be in the hydraulic system.



NOTE:4WD shaft removed for clarity

5.Underneath the tractor,at the front of the tunnel ,locate the hydrostatic transmission, Remove the plug in the charge pressure test port.
6.Assembled test equipment as shown and install to test port.
7.Start engine and run at high idle (2500~2700rpm).
8.Check pressure reading gauge.

Specifications:
Charge Pressure------1723-2068KPa(250-300psi).

Results:
-Charge pressure should reach 1723-2068KPa (250-300 psi) cannot obtained;the mesh inlet filter may be restricted,the suction line may be restricted or leaking air,or front hydraulic pump may be defective

4. HYDRAULIC SYSTEM BLEED PROCEDURE

Reason:
To remove air trapped in the hydraulic system which will prevent proper operation.
Procedure:

IMPORTANT: If contamination is found in hydraulic system filter or inside reservoir,flush entire hydraulic system.
NOTE: Fill the hydraulic oil filter with new oil before installing.

1.Install a new hydraulic oil filter.
2.Fill the transaxle with specified and recommended Transmission oil to the proper level in sight glass.
3.Disconnect in plug to fuel shutoff solenoid.
4.Turn the key to START and hold for 10 seconds.Turn the key to OFF.
5.Reconnect wires to fuel shutoff solenoid.
6.Raise tractor front end and support on suitable stands.
7.Start the engine and run at low idle.

IMPORTANT:If steering fails to respond, or pump pressure is not being delivered to steering control unit(SCU),shut engine off and check to see that steering hoses are connected to the correct SCU ports.

8.Slowly turn the steering wheel left and right until wheels turn smoothly indicating that any trapped air has been bled back to the reservoir.

IMPORTANT:If rock shaft fails to react to lift control lever movement,shut engine off and check hose clamps on suction tube elbow and manifold to ensure that they are properly tightened.

9.Operate rockshaft several times until it operates smoothly.
10.Stop the engine and check the hydraulic reservoir oil level.Fill as needed.Check all line connections for leaks;tighten if necessary.
11.Lower the tractor to the ground.
12.Drive tractor in forward and reverse several times until transmission operates smoothly.

1.TRACTOR SPLITTING (FRONT)

Note: It is not necessary to remove the flywheel housing from the engine unless engine is being removed.Split the tractor between the tunnel and flywheel housing as outlined in the story below.

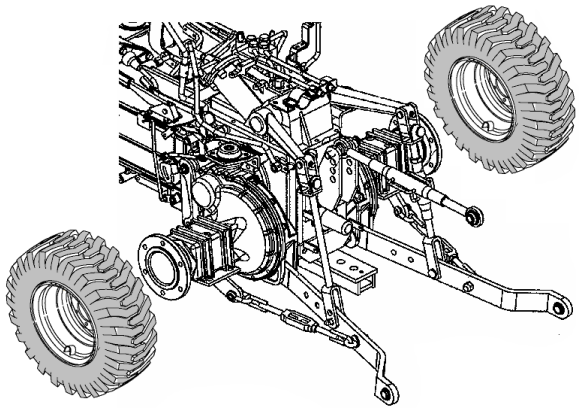
Prepare the Tractor:

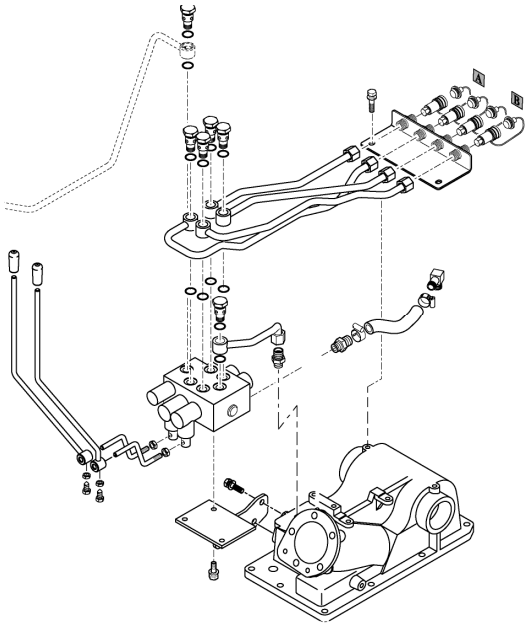
1.Remove any mid or front attachments and mid .
2.Park tractor on a level surface.Engage park brake,shut off engine.
3.Disconnect battery negative terminal.
4.Remove floor mat.
5.Remove the operator's platform.
6.Remove LH and RH closeout panels.
7.Remove seat and seat platform.
8.Remove fenders.
9.Cycle all hydraulic controls to relieve system pressure.

CAUTION:	To avoid injury from escaping hydraulic oil under pressure ,relief the pressure in the system by stopping the engine and operating all hydraulic control valves.

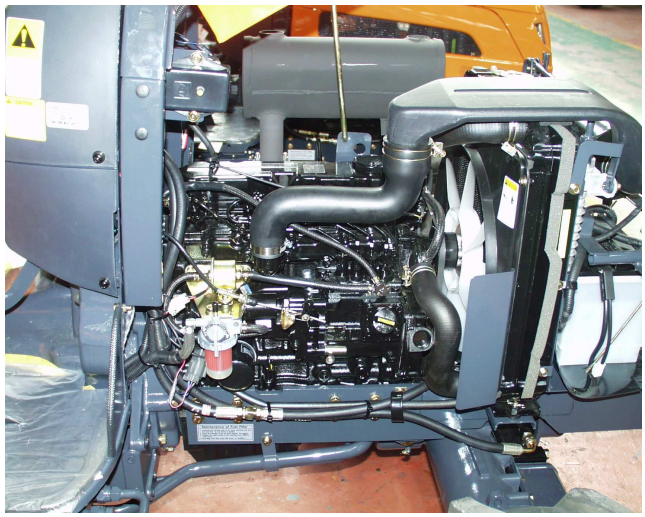
Note: Hydraulic reservoir contains approximately 26L(6.8gal) of oil.Have a suitable container ready to catch drain oil.

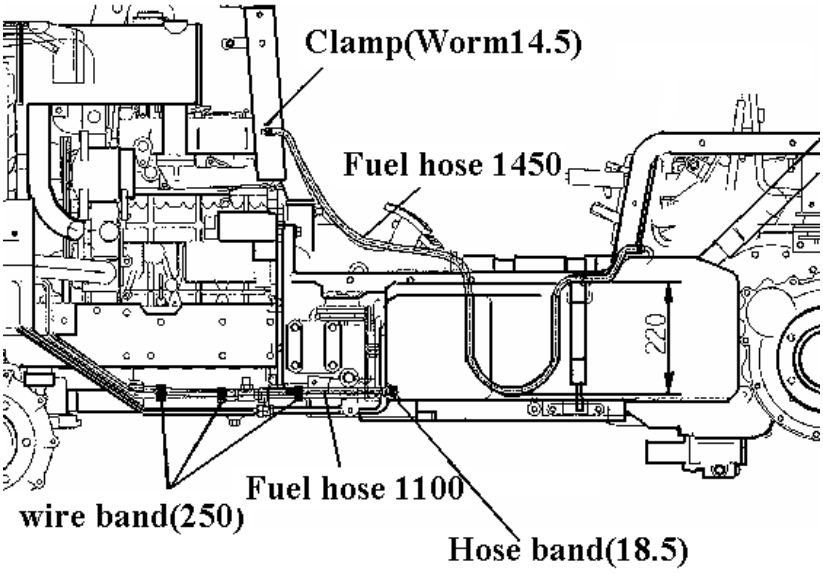
10.Drain hydraulic reservoir.
11.If tractor is equipped with SCV,raise RH rear of tractor and support on suitable stands.
12.Remove RH rear wheel and tire.

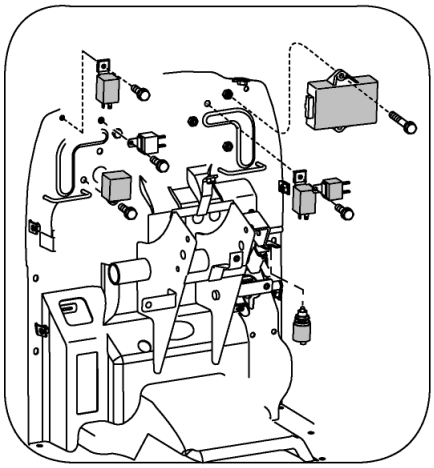




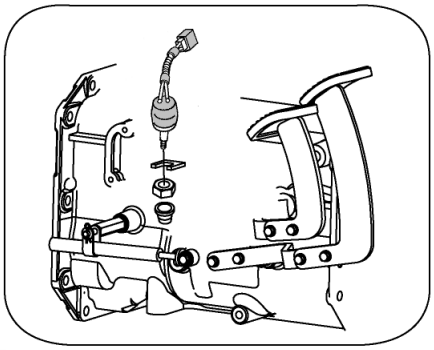
13.Disconnect two work port tubes form SCV
14.Remove two cap screws and two spacers that attach tube support bracket to frame. Remove tube support bracket and as an assembly.
15.Install RH rear wheel and tire.
16.Locate and disconnect all electrical connectors attaching wiring harness switches and lights on rear half of tractor.Unfasten wiring harness from cable clips and move harness away from rear half of tractor.

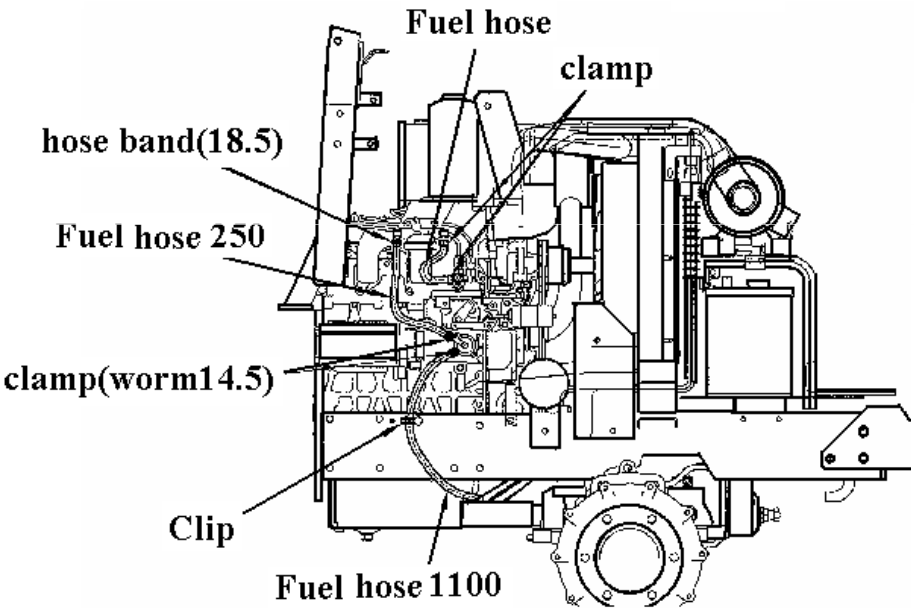


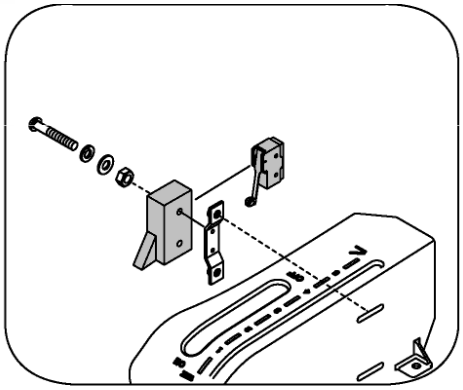


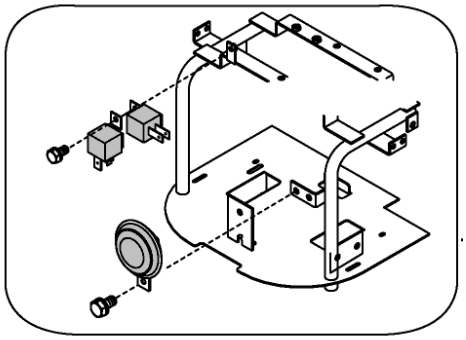


All electrical connectors attaching wiring harness switches and lights on rear half of tractor.

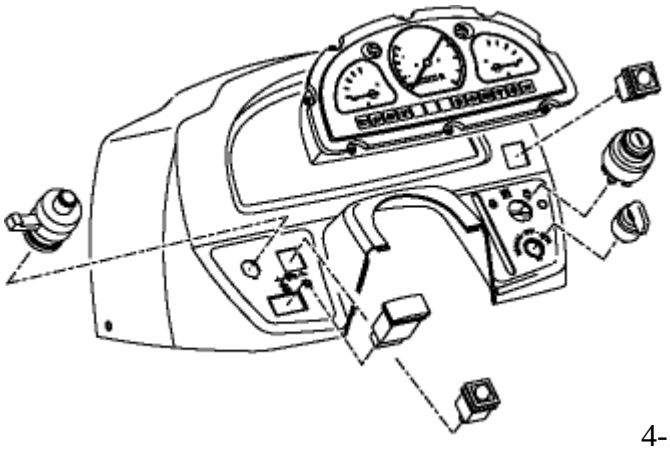


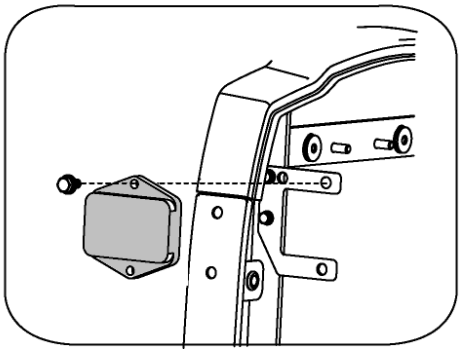




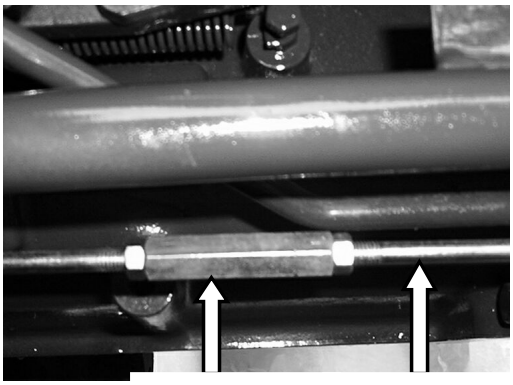


All electrical connectors attaching wiring harness switches and lights on front half of tractor.



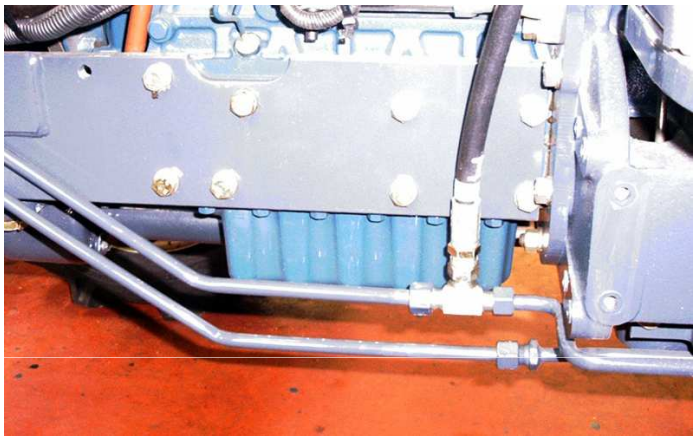


17.Disconnect lower brake rods at rear brake levers.
18.Remove turnbuckle at front of lower brake rods, and remove brake rods from tractor

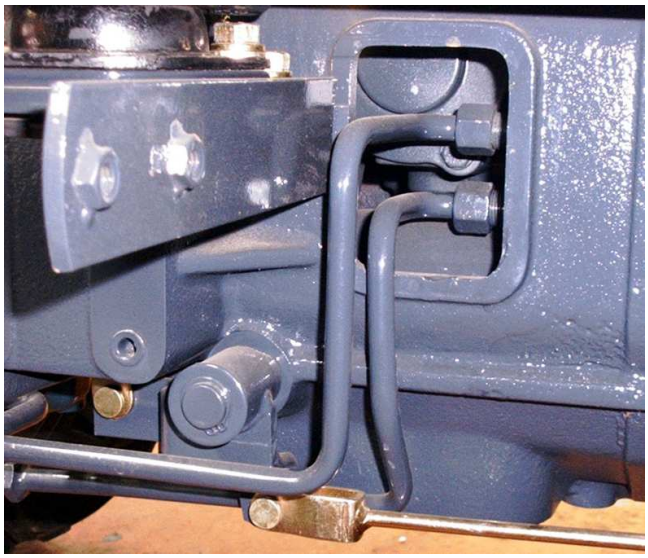


Turn buckle Brake rod.

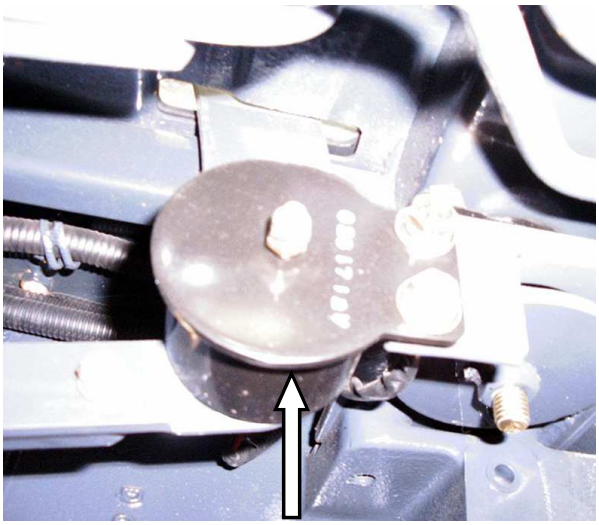
19.Disconnect hydraulic pressure tube at lower Left side of Transmission



20.Remove hydraulic pressure tube clamp

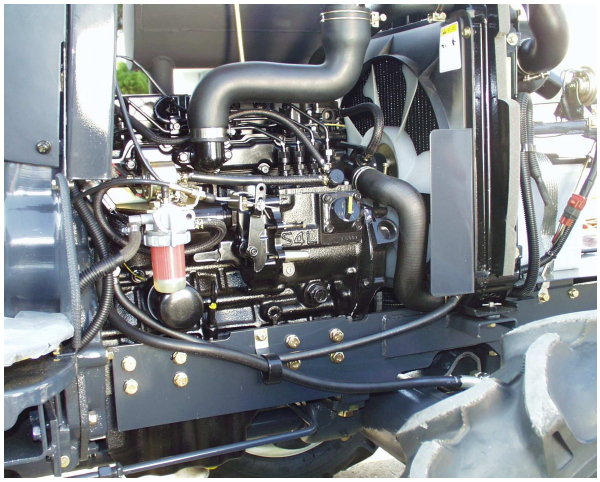


21.Remove magnetic cruise at front transmission

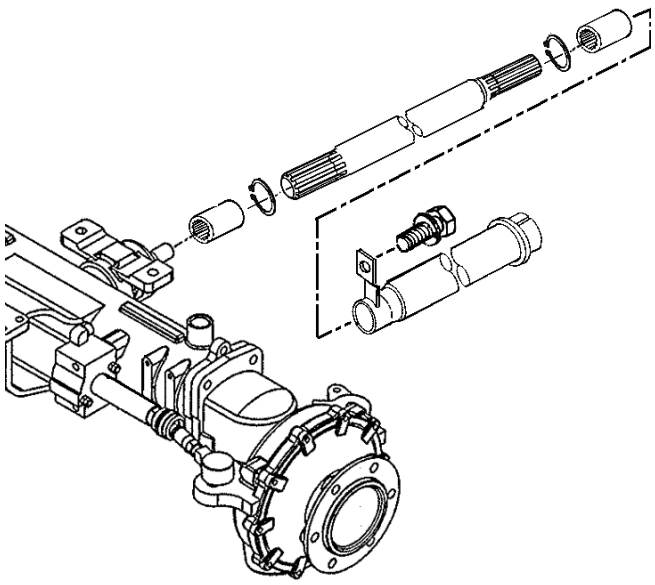


Magnetic cruise

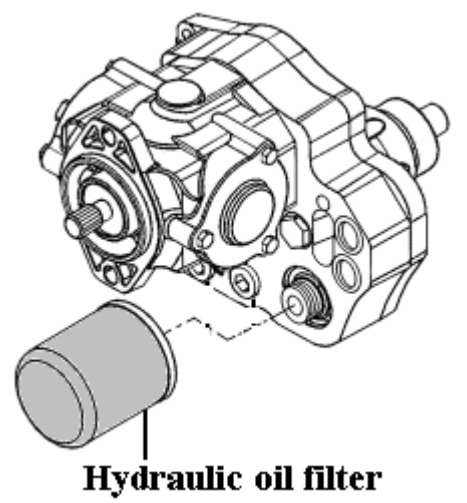
22.Disconnect hydraulic supply tube at SCV or manifold block,Remove tube.



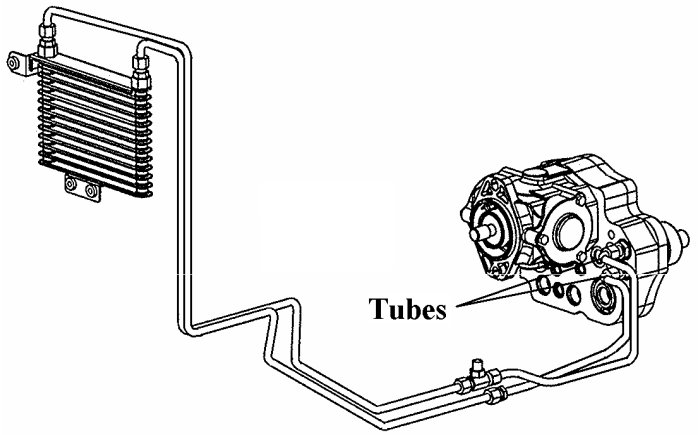
23.Remove 4WD drive shaft and couplers by removing snap ring and sliding couplers onto shaft until clear of stub shaft



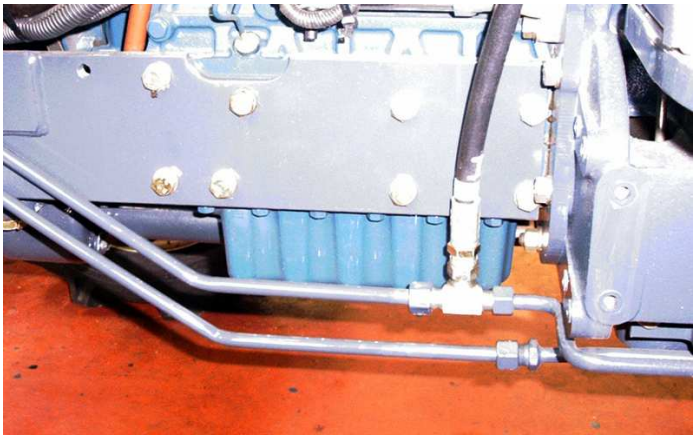
24.Remove hydraulic filter.



25.Disconnect two hydraulic charge pressure tubes from hydrostatic transmission

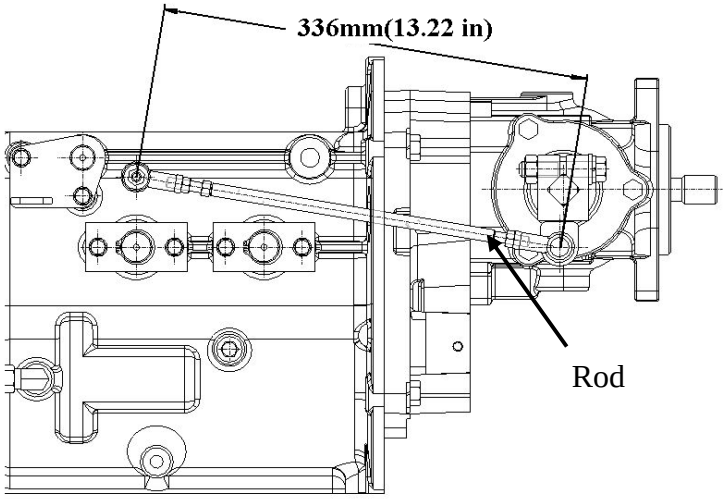


26.Loosen hose clamp and disconnect suction tube from manifold.

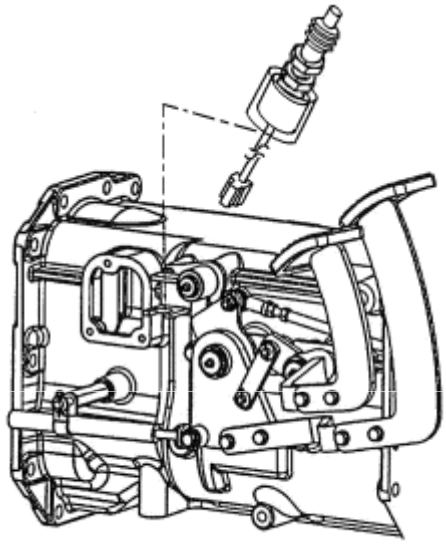


NOTE:Tractor shown split for clarity.

27.Disconnect rod from hydrostatic control linkage.



28.Disconnect switch connector



29 .Remove 5 screws connecting tunnel to flywheel housing.Note length and location of screws when removing.

IMPORTANT: Check for ,and disconnect any additional accessory wires or hydraulic tubes connecting rear half to front half before splitting tractor.

30.Release park brake and place gear shift in NEUTRAL.

31.Gently pry around edges of flanges to separate tractor halves.

32.Roll tractor halves apart.

Assemble Tractor Sections.

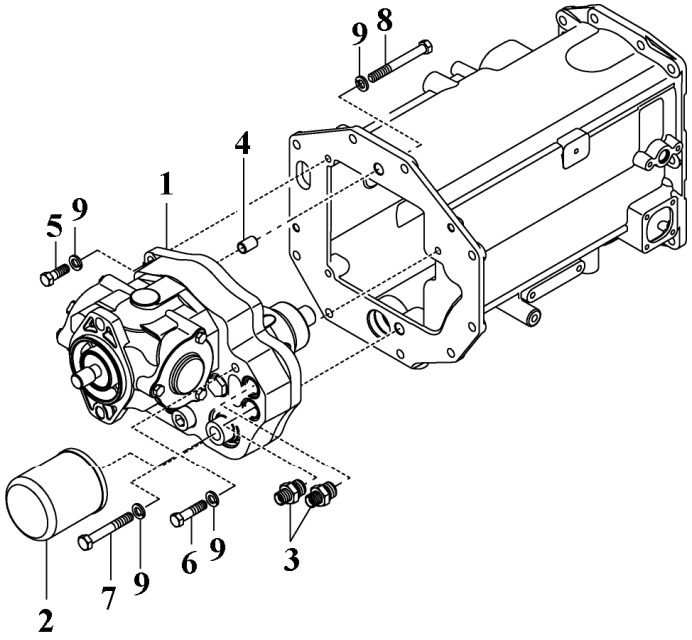
NOTE:Splines on all drive shafts and couplers must be aligned before tractor sections are bolted together.

1.Align splines on hydrostatic transmission drive shaft and engine fly wheel.

2.Move tractor sections together and retain with 5 screws.Tighten bolts to 90-110N.m.

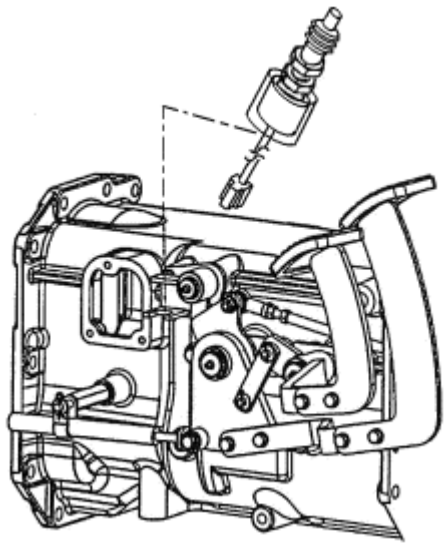
3.Remove screws retaining splitting stands to tractor sections.Remove splitting stands.

NOTE: Tractor shown split for clarity.

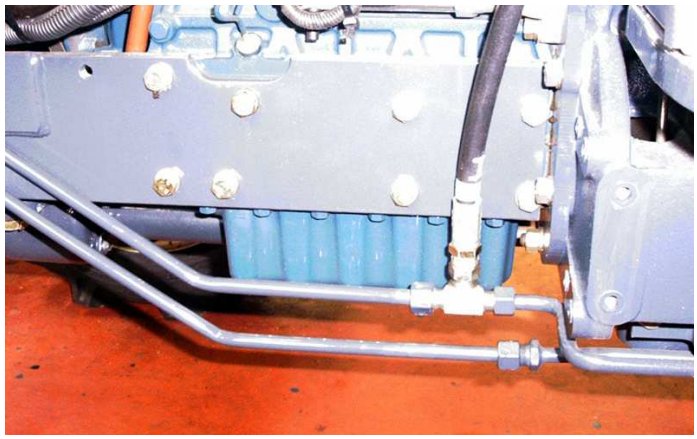


4.Install rod as an assembly.Attach turn buckle to hydrostatic control linkage and retain with nut.

5.Connect switch connector

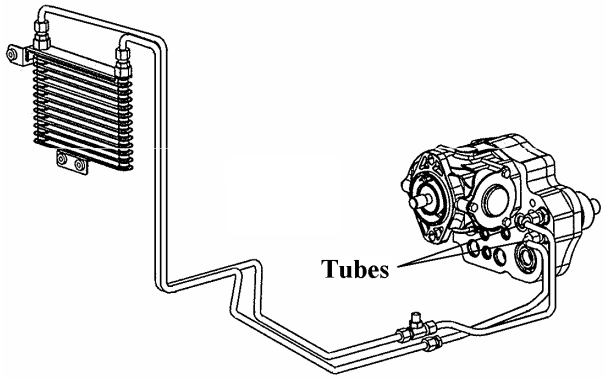


6.Connect suction tube to manifold.Tighten hose clamp

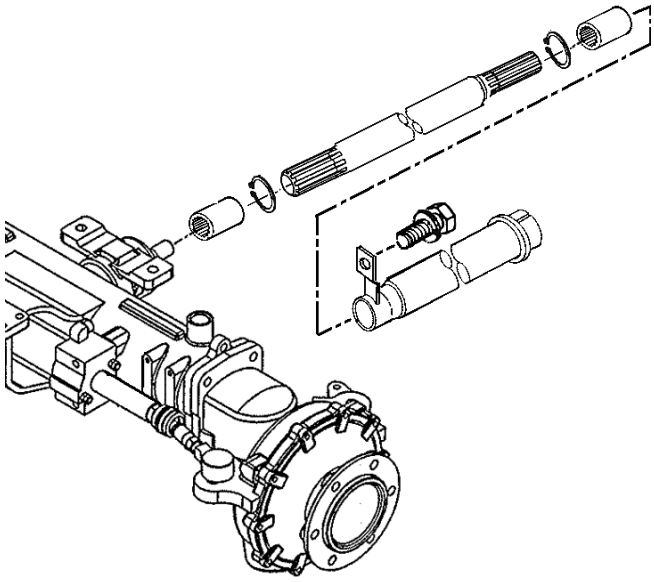


7. Connect two hydrostatic charge pressure tubes to hydrostatic transmission.Tighten to 40-57N.m (30-43lb-ft).Check opposite ends of both tubes to make sure they are tight.

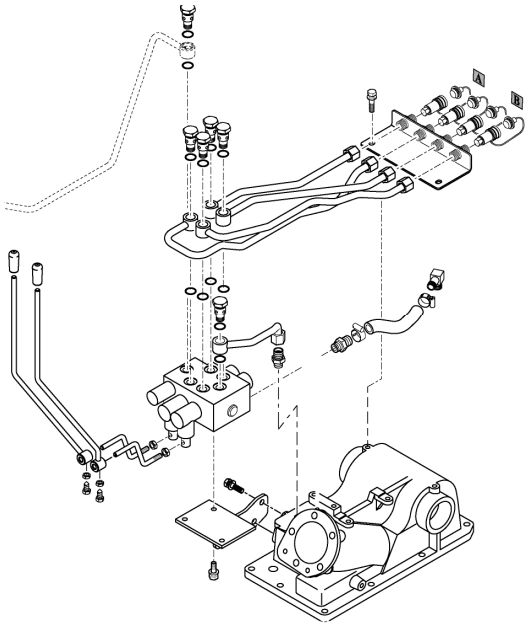
8. Install a new hydraulic oil filter



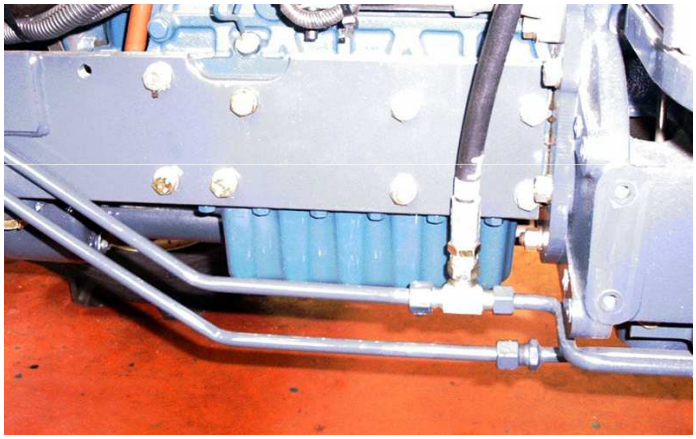
9. Install 4WD drive shaft and couplers. Slide



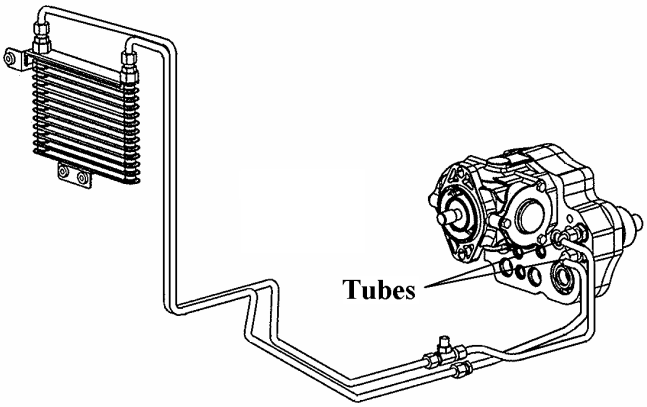
10. Install hydraulic supply tube to tractor.
Connect hydraulic supply tube to SCV.
Tighten tube nut to 55-79N.m(40-59lb-ft).



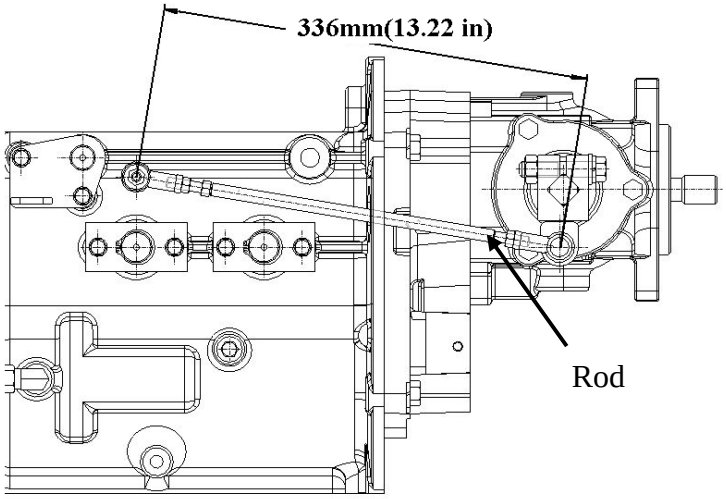
11.Connect hydraulic pressure tube at lower Left side of Transmission



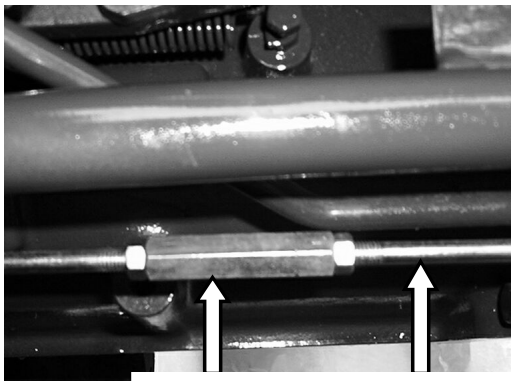
12.Install hydraulic pressure tube clamp



13. Install brake rods to brake bell cranks.
Retain with specified length

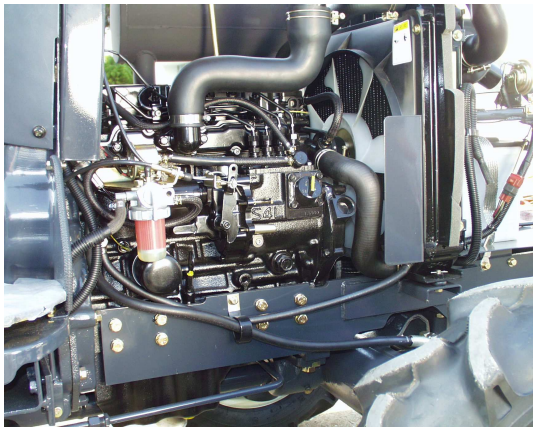


14.Connect lower brakes rods to rear brake levers.Retain with turn buckle and nuts.



Turn buckle **Brake rod.**

15.Route wiring harness through cable clips. Locate and connect all electrical connectors attaching wiring harness to switches and lights on rear half of tractor.



16.Install SCV tube support bracket and tubes as an assembly.Install two cap screws and two spacers to attach tube support bracket to frame.

17.Raise RH rear of tractor and support on suitable stands.Remove RH rear wheel and tire.

18.Connect four work port tubes to SCV.
Tighten tube nuts to 40-57N.m(30-43 lb-ft).
19.Connect battery negative terminal.
20. Install fenders.
21.Install seat and seat platform
22.Install LH and RH closeout panels.
23.Install operator's platform.
24. Install floor mat.
25.Refill hydraulic oil reservoir to proper level.
26.Bleed air from hydraulic system
(See HYDRAULIC SYSTEM BLEED PROCEDURE)

2.HYDRAULIC TRANSMISSION REMOVAL & INSTALLATION

Removal:
1.Park tractor on level surface.Stop engine and release hydraulic pressure by operating all controls.

CAUTION	To avoid injury from escaping hydraulic oil under pressure ,relief the pressure in the system by stopping the engine and operating all hydraulic components

2.Separate tractor engine and tunnel sections.
(See TRACTOR SPLITTING(FRONT).
3.Remove two cap screws,two spacers,and two lock nuts,and disconnect transmission forward and reverse control rods.

CAUTION	Hydraulic transmission weights approximately 34Kg(751lb).attach a suitable lifting device to transmission before removing screws

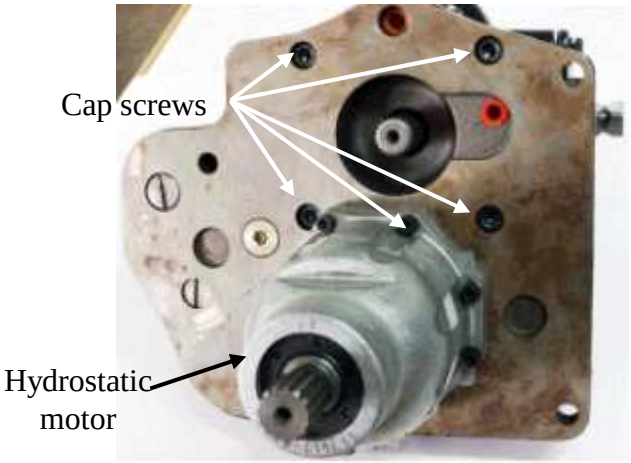
NOTE: 1 screw is removed from the top of the tunnel section ,from the outside.
4. Remove five screws attaching transmission to tunnel section.Note length and location of screws when removing.
NOTE:Oil may drain from the pump and motor unit after it is removed.Have a suitable container ready to catch excess oil.
5.Gently pry around edges of flanges to break sealant.Remove transmission.

NOTE: Drive shaft may come out with transmission.If removed with transmission,remove from transmission,and install into tunnel and range transmission.

Installation:
Installation is the reverse of removal.
- Clean flanges of transmission and tunnel before applying sealant.
- Apply TB1215 sealant to flanges of transmission where it contacts the tunnel.
- Tighten the screws attaching transmission to tunnel to 126-154 N.m(95-115lb-ft).

IMPORTANT:
If neutral adjustment locking screws was loosened,neutral adjustment procedure must be performed. See "**HYDROSTATIC PEDAL AND NEUTRAL ADJUSTMENT**"

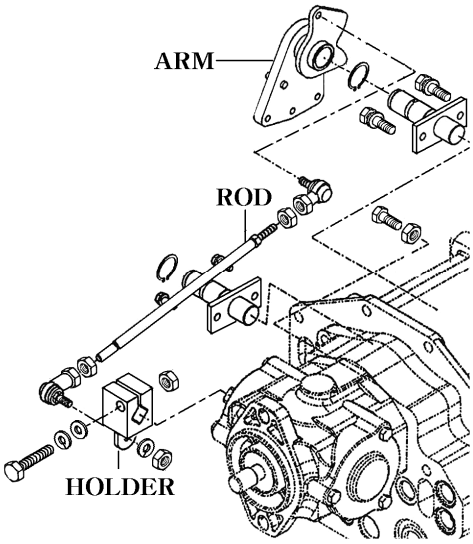
3.HYDROSTATIC TRANSMISSION DISASSEMBLY



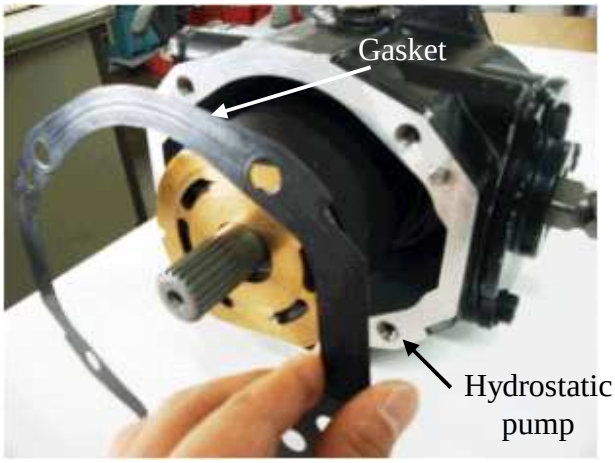
IMPORTANT: The pump body and motor body are aluminum and can be easily damaged by steel tools.Be careful to not damage machined surfaces.Do not use screw driver or other sharp objects to pry pump or motor body from back plate.

1.Remove eight socket head screws Securing the hydrostatic motor to the back plate.tap of the motor housing with a plastic mallet to loosen it from the valve plate.Keep the assembly level or tip output end down to keep the rotating assembly from sliding off of shaft.Pull the motor housing,shaft,and rotating assembly away from back plate.

2.Remove the four socket head cap screws securing the pump to the back late. Remove pump.

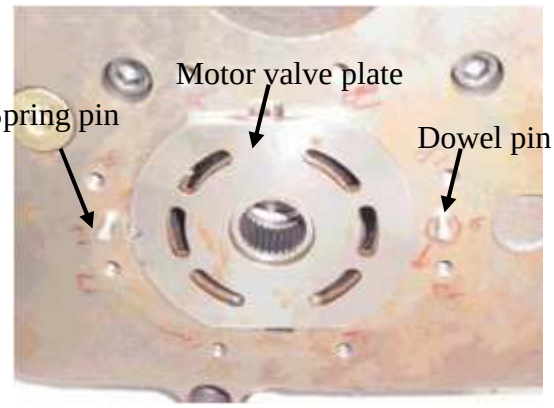


3.Remove cap screw and nut.Remove holder and arm as an assembly.



4. Remove gasket from pump assembly.

Back plate Disassembly:

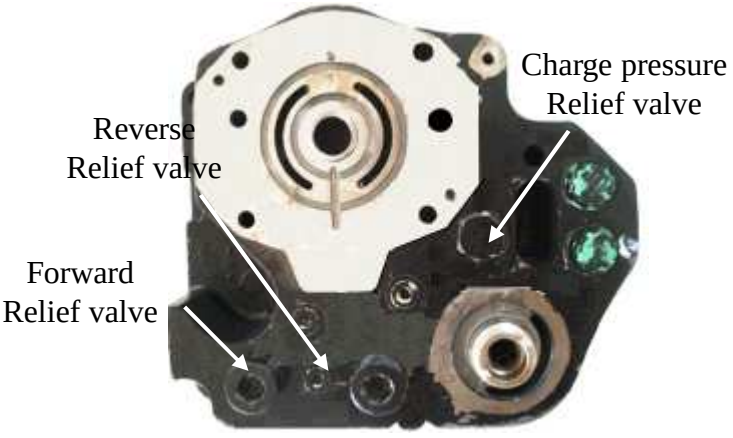


NOTE:Pump and motor valve plates are very similar in appearance,but are not interchangeable.Note shape of valve plates when removing.Valve plates are not fastened to back plate,but may adhere slightly because of oil between the machined surfaces.

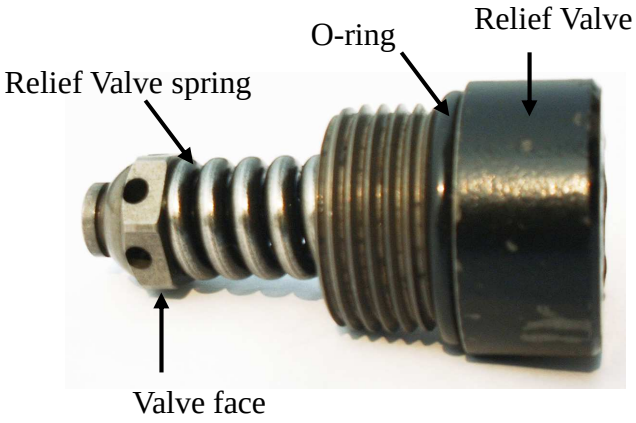
5.Remove valve plates from the back plate.

6.Remove two dowel pins.

NOTE:Unless spring pin used to locate valve plate is damaged or loose,do not remove.If replacement is necessary, Use care not to scratch the machined surfaces of the back plate.



7.Mark the forward and reverse relief valves and their ports to ensure they go into the correct holes during assembly.Remove the relief valves from the back plate.Clean the relief valves in a suitable solvent,and check for damaged springs or seats.



NOTE: The relief valves are dual purpose valves. Each valve contains two springs.A weak spring (check valve when other circuit is in use) and a strong spring(6000psi relief valve).Valves can not be adjusted,and there is no serviceable parts inside. If any malfunction is suspected,replace the relief valve.Valve face

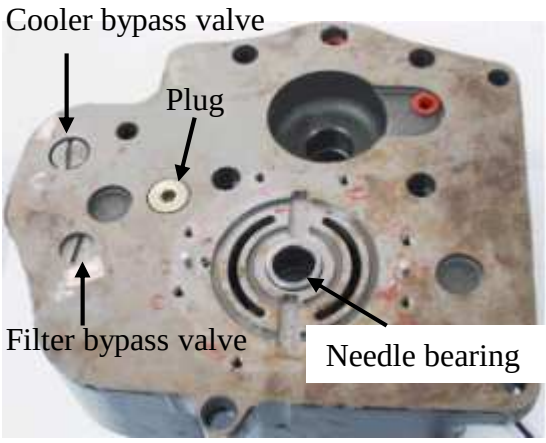
8.Examine the relief valve faces,and the seats in the back plate.The faces of the check valve and the seats in the back plate should be free of burns and defects.

IMPORTANT:Damage to pump may occur if charge pressure relief valve and cooler bypass valve springs are accidentally swapped.Keep valves and springs separated or label them to prevent mix-up.

9.Remove the charge pressure relief valve and check for damage or debris in spring or seating areas. Clean or replace parts as required.

IMPORTANT:To avoid damage to needle bearings When removing or installing,press only against side of bearing with lettering.
When removing bearings from the back plate,be Extremely careful to not damage machined surfaces.

10.Inspect pump side needle bearing.Bearing should spin freely,and needles should not fall out of bearing cage.If replacement is necessary, press bearing out from the motor side of the housing.

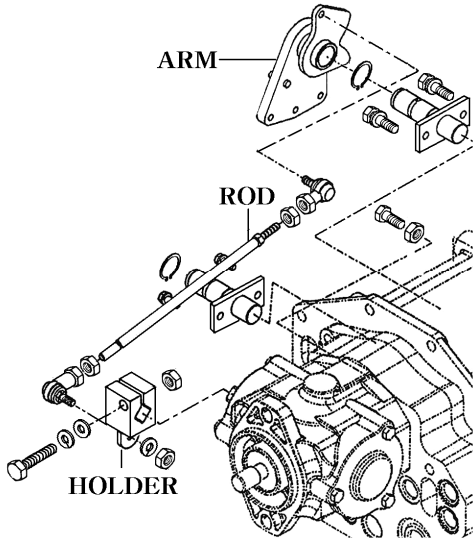


11.On the motor side of the back plate,remove the cooler bypass valve and check for damage or debris in spring or seating areas.Clean or replace parts as required.

12.Remove the filter bypass valve and check for damage or debris in spring or seating areas. Clean or replace parts as required.

13.Inspect the motor side needle bearing.Bearing should spin freely,and needles should not fall out of bearing cage. If replacement in necessary, remove using a suitable blind hole puller.

14.Remove three plugs from pump side,and one plug from motor side of back plate, and clean out oil passages using a suitable solvent and compressed air.



NOTE: If neutral adjustment cap screw is loosened,neutral adjustment procedure must be performed.see “HYDRAULIC PEDAL AND NEUTRAL ADJUSTMENT”

15.Inspect pivot and cam followers on neutral return lever for smooth operation.Replace parts as needed.

Back plate Assembly:

1.On motor side of the back plate,install the filter bypass valve.Tighten to 16-20N.m (12-15lb-ft).

NOTE:Cooler bypass valve spring and charge relief valve spring could accidentally be mixed up.Charge relief valve spring is thicker.

2.Install the cooler bypass valve.Tighten to 28-33 N.M(21-24 lb-ft).

IMPORTANT: Old O-rings,gaskets and seals will leak.Always install new O-rings, gaskets and seals during assembly.

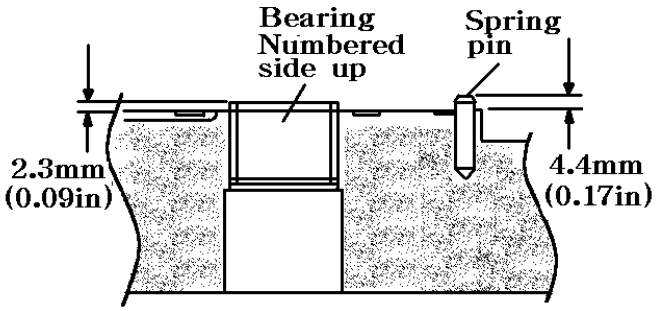
3.Install new O-ring to plug.Install plug. Tighten to 13-16N.m(115-142lb-in)

4.On pump side of back plate,install new O-ring to the three plugs.Install plugs. Tighten to 135-149N.m(100-110 lb-in).

5.Install forward and reverse relief valves in ports marked at disassembly.Tighten to 135-149N.m(100-110lb-ft).

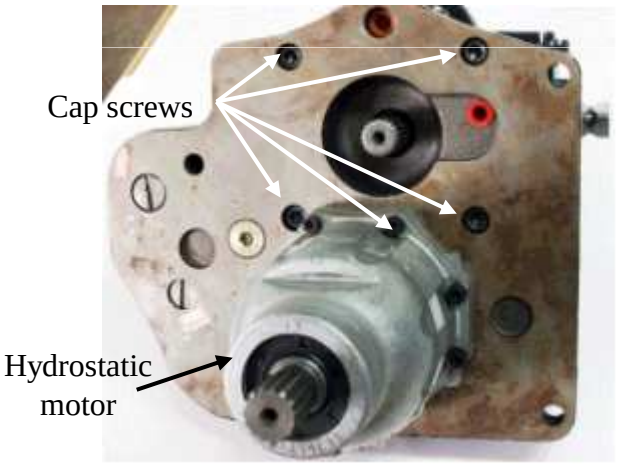
6. Install charge pressure relief valve.Tighten to 37-41N.m(27-30lb-ft).

7.Install two dowel pins.



8. If the bearings were removed from the back plate,press new ones into position using a suitable bearing driver.The numbers on the bearing should face the outside of the back plate.press the bearing in until 2.3±0.2 mm (0.09in ±0.010in) of the race remains above the surface of the back plate.
9. If removed,install the spring pin that is used to position the valve plate.Allow the pin to protrude from the back plate approximately 4.4mm(0.17in).

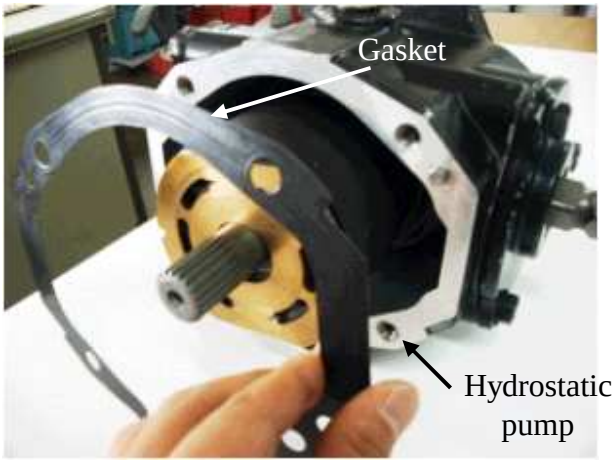
4. HYDRAULIC PUMP DISASSEMBLY



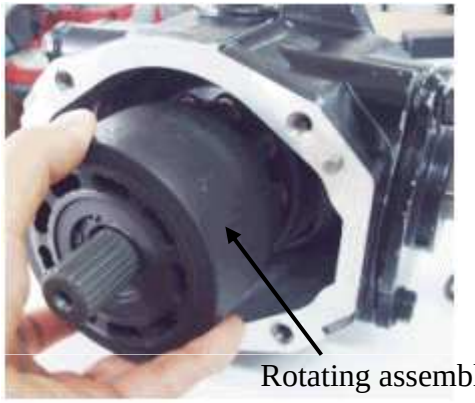
IMPORTANT: The pump body is aluminum and can be easily damaged by steel tools. Be careful to not damage machined surfaces. Do not use screw driver or other sharp objects to pry pump body from back plate.

1.If not already done,remove four socket head cap screws securing the pump to the back plate .Tap pump body with a plastic mallet to remove pump.

2. Remove cap screw and nut.Remove speed control lever and neutral switch as an assembly.

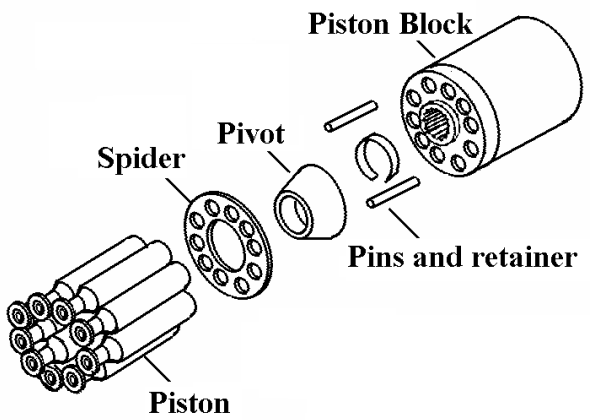


3.Remove gasket from pump assembly.



4.Remove the rotating assembly from the housing.

5.If the piston did not come out with the piston block,remove the pistons along with the spider and pivot.



NOTE: Disassembling the piston block assembly is not necessary unless the spring or pins are damaged.

⚠ CAUTION

The spring inside the piston block is compressed and should not be removed without compressing the spring first.Use the following procedure to remove the spring safely

The following parts will be needed to disassemble the piston block.

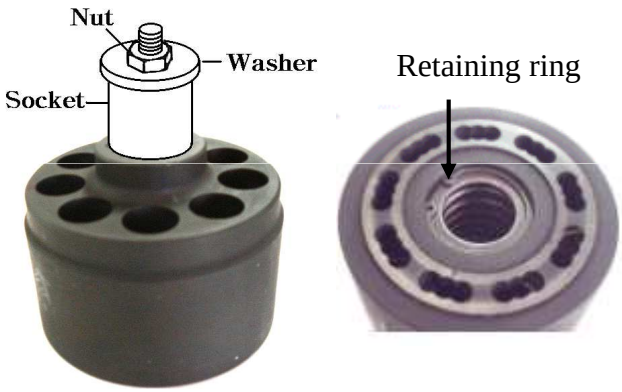
2ea----------3/8 IDX1-1/4 in .OD flat washers.

1ea----------3/8X 5in.N.C. cap screw

1ea----------3/8 in .N.C.nut

1ea----------1/2 in.Drive Socket with 1-1/8 in.OD

6.Place one of the flat washers over the 3/8X 5 in cap screw.Install cap screw through spline end of piston block so that the washer rests on the three pins.



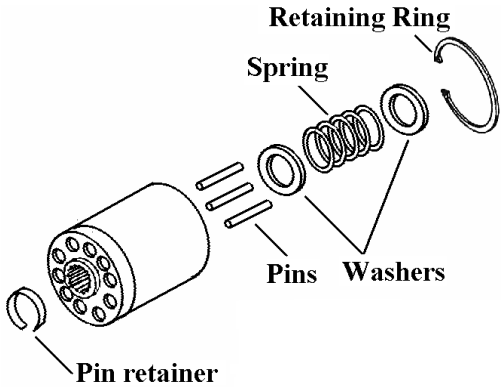
7.Place the socket,then the washer over the end of the cap screw.

8.Screw on nut and slightly compress the spring inside the piston block.

9.Using snap ring pliers,remove the internal retaining ring.

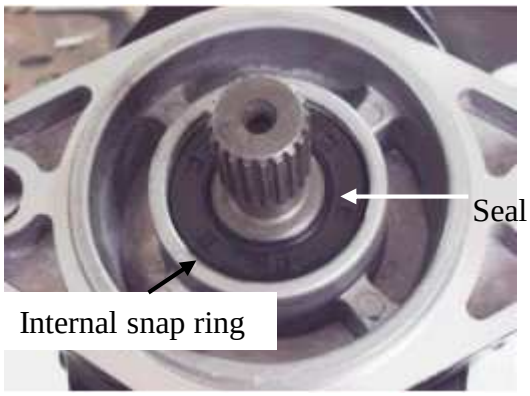
10.Carefully back off nut until spring tension is relieved.

11.Remove the nut,washer,and cap screw.



12.Remove washers,springs,pins,and pin retainer.
13.Inspect parts for wear or damage.Replace if needed.

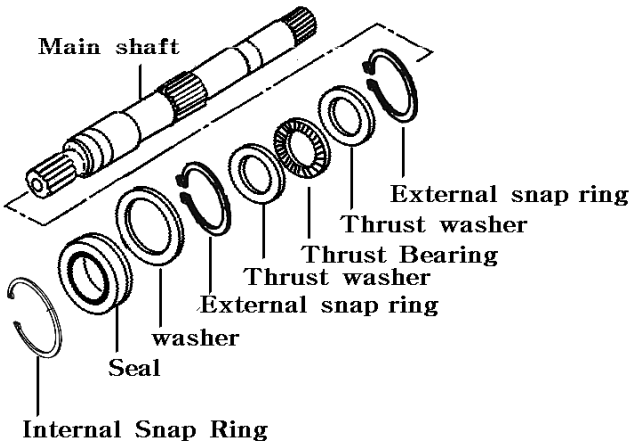
Shaft removal and Disassembly:



1.Remove the internal snap ring retaining the seal.

NOTE: Use care when pressing shaft out of housing to prevent shaft from falling to floor and being damaged.

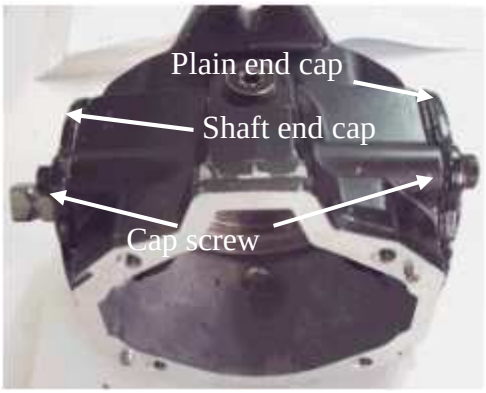
2. Press the shaft out of the housing from the back plate side until the seal releases from the bore.



3.Remove the seal and washer.

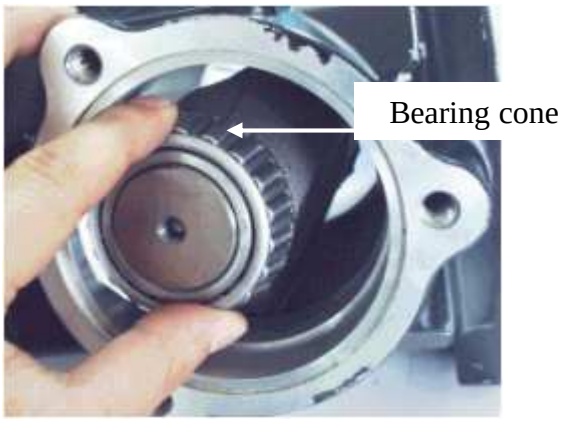
4.Remove the retaining Ring from the shaft. Remove thrust washers and thrust bearing.

Control disassembly.

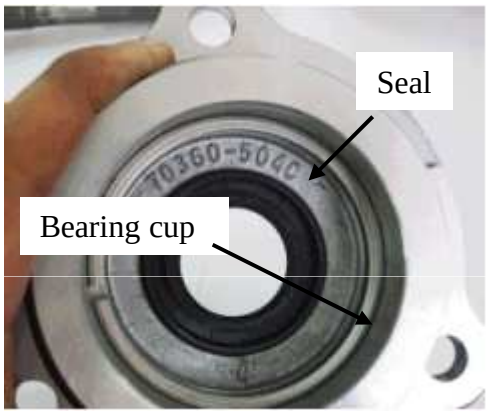


1.Remove three cap screws and shaft end cap.

2.Remove three cap screws and pain end cap.



3.Remove bearing cones from both ends of the control shaft.Inspect bearing cones for smooth operation,wear,or damage.Replace parts as needed.



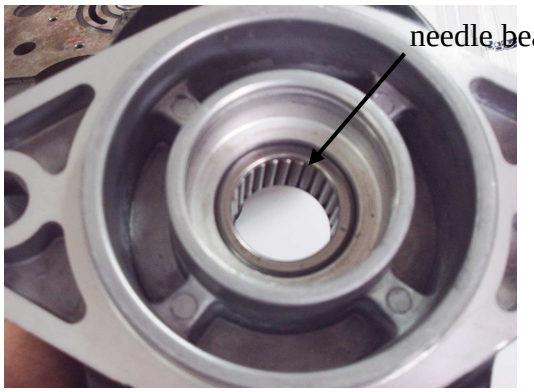
4.Replace seal in shaft end cover.

5.Inspect bearing cups for wear or damage.Replace bearings as needed.

6.Remove cam plate from housing.

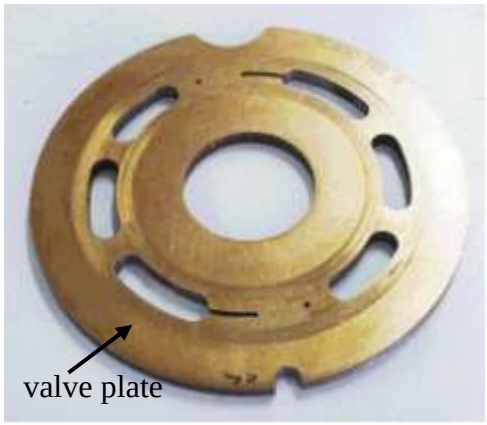
7. Remove shim.

8. Remove thrust plate.

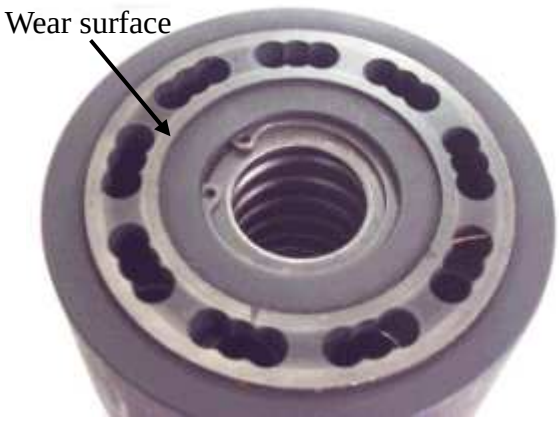


9.Inspect needle bearing in housing,If the needles remain in the cage and spin freely, there is no need to replace them,If replacement is necessary,bearing may be removed with a bearing driver.

5.HYDROSTATIC PUMP INSPECTION

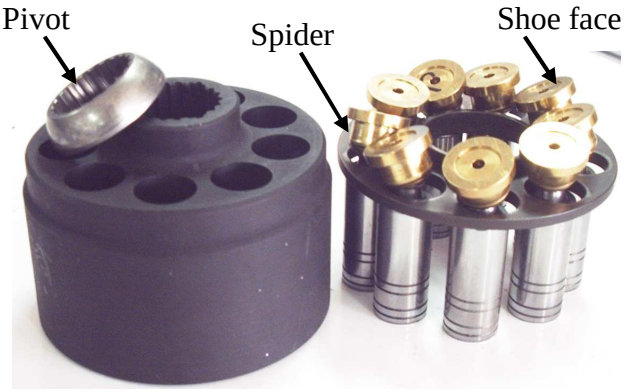


1. Inspect the bronze side of the valve plate for wear.Replace the valve plate if any wear,scoring,or scratched exist.



2.Inspect the piston block surface that makes contact with the valve plate.This surface should be smooth and free of deep scratches.

3.Check the piston movement in the block bore.If the pistons are sticky in the bore,examine the bore for scoring or contamination.



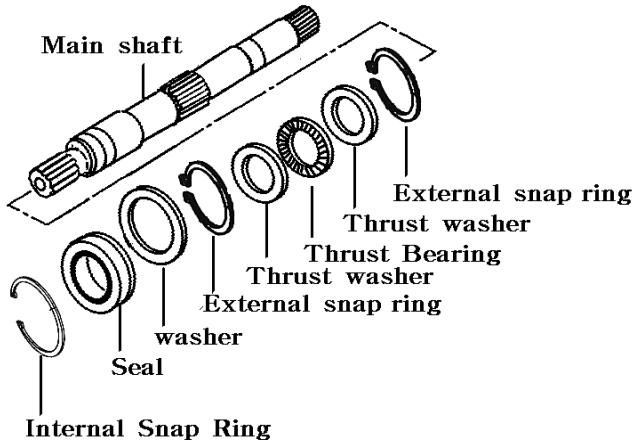
4.Inspect the outside of the pistons .Replace if scored or worn.

5.Inspect the shoes.Replace if loosed on the ball end of the piston,or if shoe face area is worn or damaged.

6.Inspect the spider.Replace if worn in the area where it contacts the pivot.

7.Inspect the pivot.Replace if worn or damaged.

8.Examine the machined surfaces of the back plate.Replace if scored or damaged.



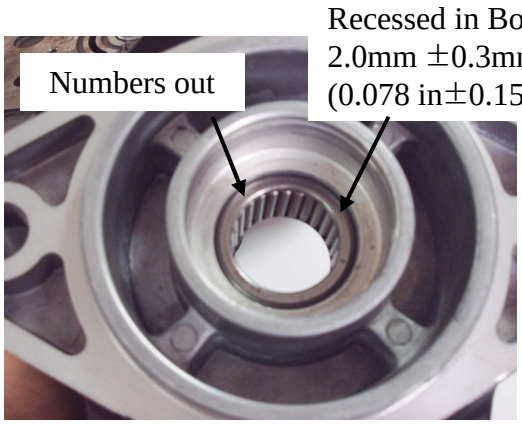
9.Inspect the shaft for damage on the bearing surfaces or in the splined areas.
10.Inspect thrust bearing and washers for wear.
11.Inspect the servo piston for scratched and wear.
12.Replace seal.Replace worn or damaged parts as required.

6. HYDROSTATIC PUMP ASSEMBLY

1.Clean all parts in a suitable solvent and dry with lint free rag.

IMPORTANT: Due to extremely tight tolerances and finish of internal surfaces it is very important to maintain absolute cleanliness during pump assembly.Coat all internal surfaces with clean 10W30 motor oil when assembling.

Housing and shaft assembly.

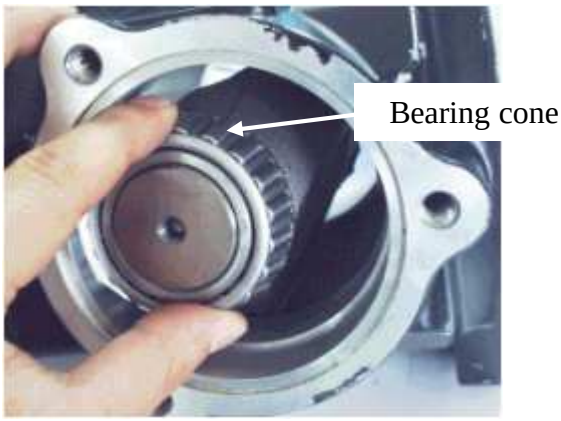


1.If the needle bearing was removed from the housing.the new one can be pressed from the outside inward until the bearing race is recessed in the bore approximately 2.0mm ±0.3mm(0.078 in±0.15in).Be sure that the numbers on the bearing race are facing to the outside of the housing.

2. Apply a small amount of grease to back of thrust plate and install thrust plate into cam plate.

3. Install shim.

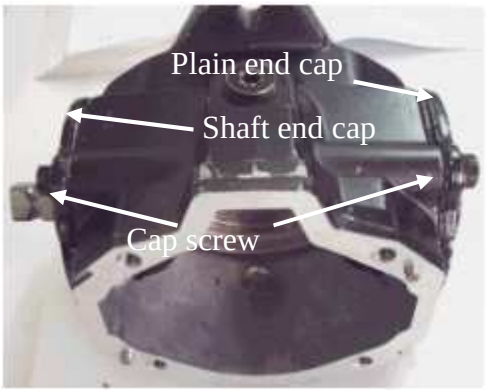
4. Install cam plate assembly into housing.



5. Install bearing cones to both ends of the control shaft.

IMPORTANT:Old O-rings,gaskets,and seals will leak.Always install new O-rings, gaskets, and seals during assembly.

6. Install new O-rings on shaft end cap and plain end cap..

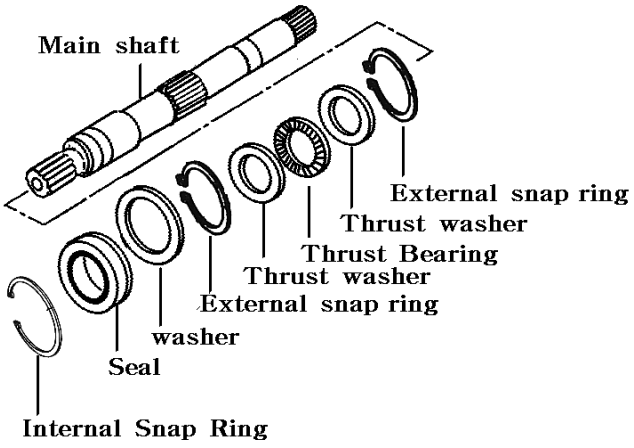


7.Install plain and shaft end caps.Retain with three cap screws.

8.Rotate control shaft and feel for smooth operation.Check for end play.If there is end play,remove shaft end cap and increase shim thickness until there is no end play.

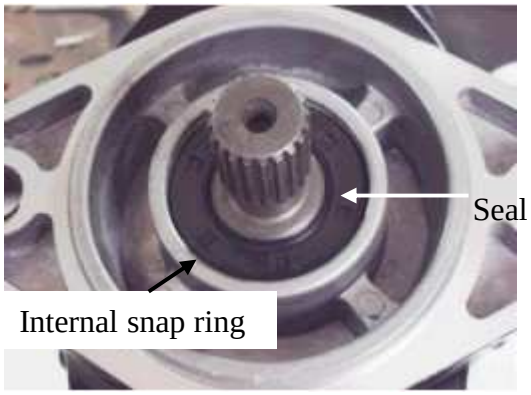
NOTE:Control shaft turning force measurement is taken while shaft is turning. Amount of force required to begin turning shaft is higher.

9.Using a suitable torque wrench,measure the amount of force required to turn the control shaft.While the shaft is turning,the amount of turning force should be 25±5lb-in.Increase,or decrease the amount of shim on the shaft end of the cam plate until the force required is within the specification.



10.install the external snap ring,thrust washer, and thrust bearing on the shaft.install the outside thrust washer and external snap ring.

11.Install the washer and a new seal onto the shaft.

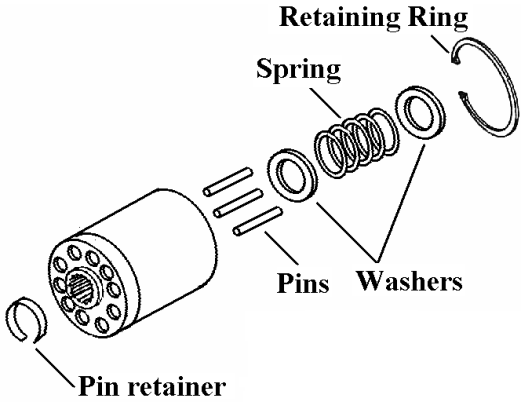


12.Install the shaft assembly into the housing. Using the appropriate size socket,or a clean piece of pipe,tap the shaft seal into the bore in the housing until the seal is below the retaining ring groove.

Secure shaft into housing with internal snap ring.

Rotating assembly installation:

1.If the piston block assembly was disassembled complete the following.If not,Skip to step 10.



2.Install the three pins in oversize grooves in spline end of piston block with the heads facing inside of the block.

3.Install the pin retainer.

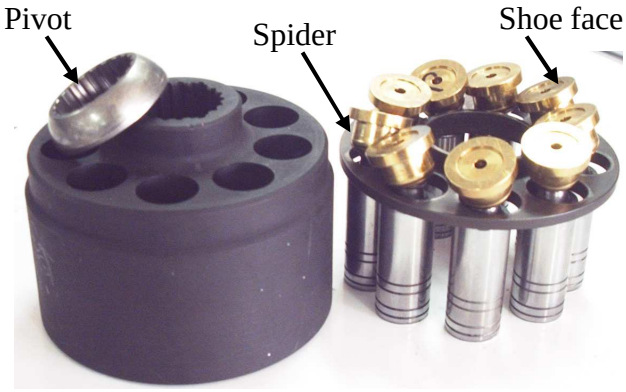
4.Install the washers and spring.

5.Using same tools used to compress spring during disassembly of block,install washer, spring,second washer,cap screw and nut in the piston block

6.Compress spring.

7.install retaining ring.

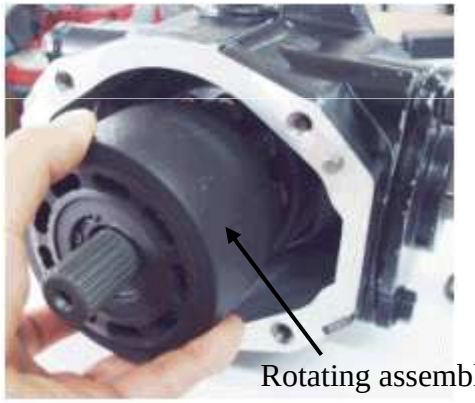
8.Remove spring compression tools from the piston block.



9.Place an appropriate size socket in the hole in the piston block to keep the pivot in place while installing the pistons.Slide the pivot down so that the flat side rests on the top of the three pins.

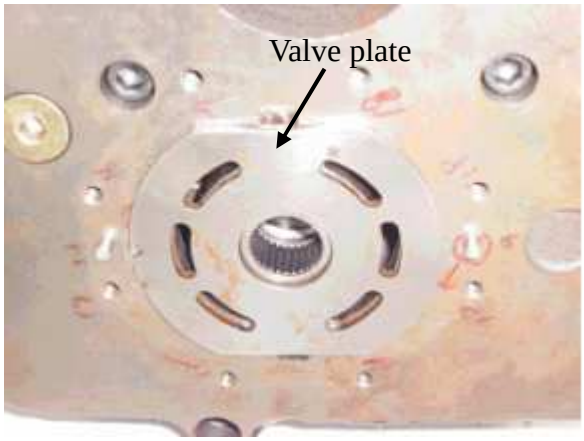
10.With the pistons in place in the spider, lower the pistons into the piston block.

NOTE: It is not necessary to put the pistons in the original position.Any piston can be installed in any hole.



11. Tilt the pump housing so that the open end is facing slightly downward.

12.Slide the rotating assembly up the shaft until it meshes with the splines on the shaft.



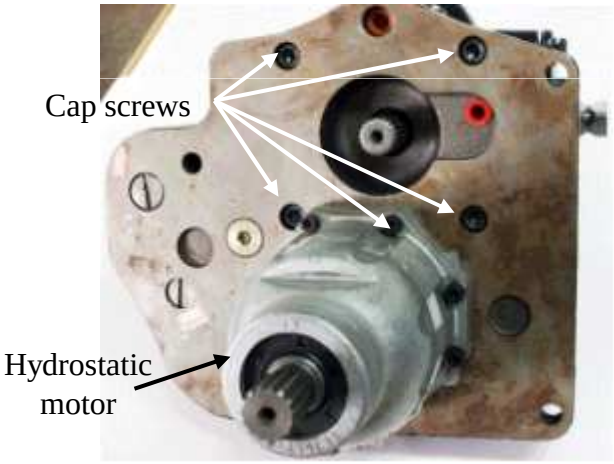
13.Apply a small amount of grease to the steel side of the valve plate to hold it in place during pump installation.

14.Install pump valve plate on back plate.

15.Place a new gasket on the pump.

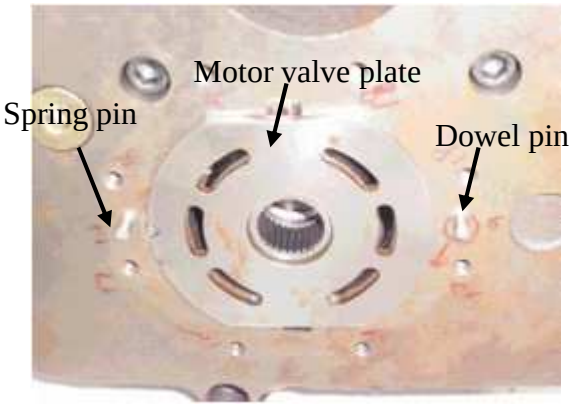
16.Install the pump assembly on to the back plate assembly.Make sure valve plate and gasket stay in position.Tighten the socket head cap screws to 37-42N.m(27-31lb-ft).

7. HYDROSTATIC MOTOR DISASSEMBLY



IMPORTANT:The motor body is aluminum and can be easily damaged by steel tools.Be careful to not damage machined surfaces. Do not use screw driver or other sharp objects to pry motor body from back plate.

1.If not already done,remove motor from back plate.Remove eight socket head cap screws securing the motor to the back plate.Tap the motor housing with a plastic mallet to loosen it from the valve plate.Keep the assembly level or tip output end down to keep the rotating assembly from sliding off of shaft.Pull the motor housing,shaft,and rotating assembly away from back plate.

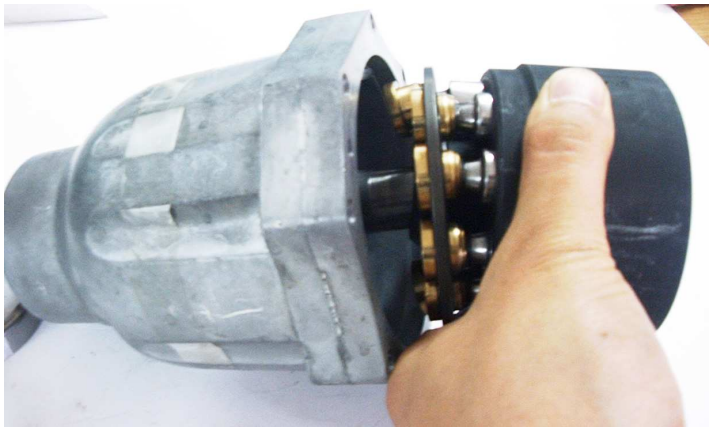


NOTE: pump and motor valve plates are very similar in appearance,but are not interchangeable.Note shape of valve plates when removing.Valve plates are not fastened to back plate,but may adhere slightly because of oil between the machined surfaces.

2.Remove valve plate from the back plate.
3.Remove two dowel pins.

NOTE: Unless spring pin used to locate valve plate is damaged or loose, do not remove.If replacement is necessary, use care not to scratch the machined surface of the back plate.

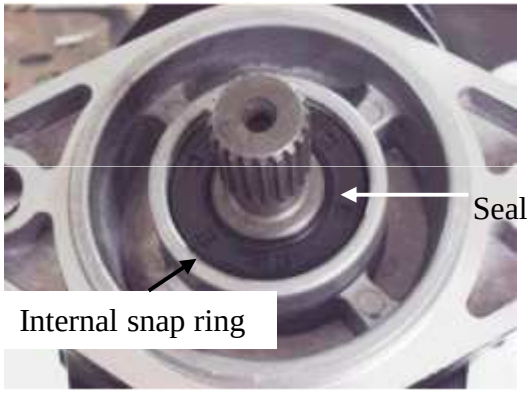
Rotating Unit Removal and Disassembly:



1.Invert the motor and remove the rotating assembly from the housing
2.If the pistons did not come out with piston block,remove the pistons along with the spider and pivot.

3. Remove cam washer from back of motor housing.

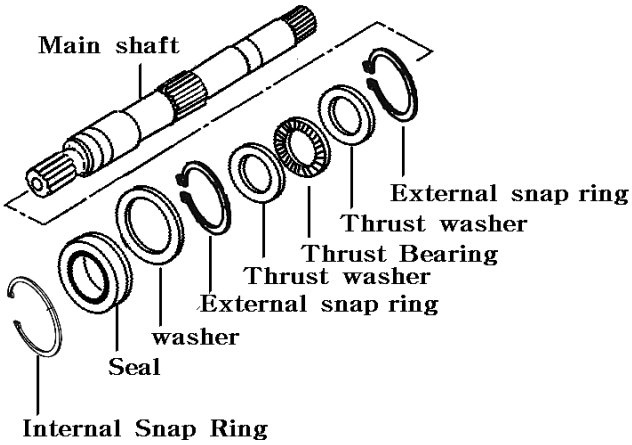
Shaft Removal and Disassembly.



1.Remove the internal snap ring retaining the seal.

2.Gently tap the shaft with a plastic hammer until the seal release from the housing.

NOTE: Use care when removing shaft from housing to prevent shaft from falling to floor and being damaged.

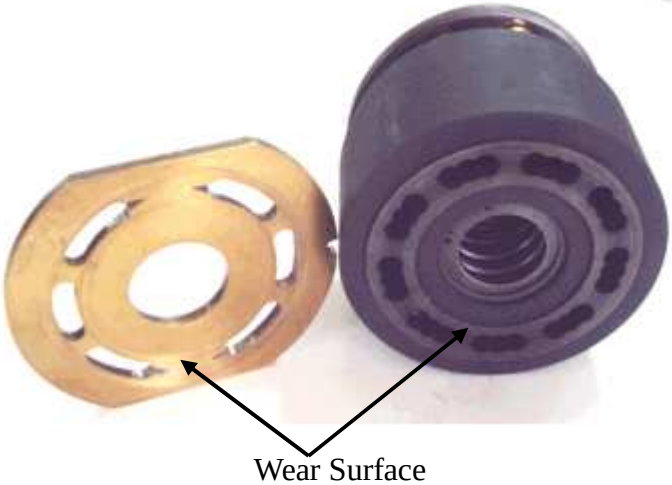


3. Remove the seal and washer.
4.Remove the retaining ring from the shaft. Remove thrust washers and thrust bearing.
5. Inspect the shaft for damage in the bearing and spline area.
6. Inspect the thrust bearing and washers for wear.

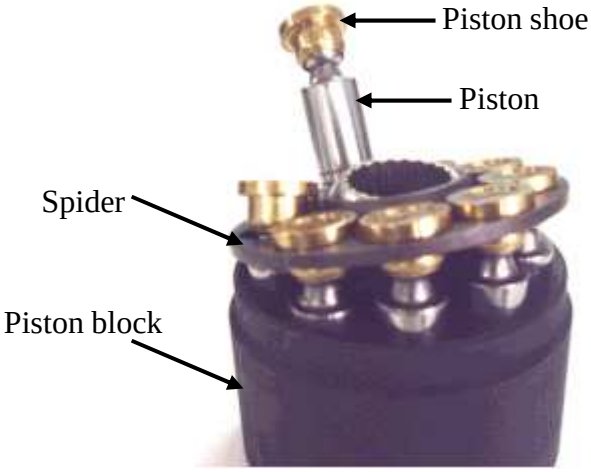
Hydrostatic Motor Inspection

1.Inspect the needle bearings in the back plate and the motor housing.If the needles remain in the cage and spin freely,there is no need to replace them.
2.If the needle bearing in the motor housing needs to be replaced, it can be pressed out with the appropriate size bearing driver.If the bearing in the back plate must be replaced it must be pulled out with a slide hammer or blind hole puller.

IMPORTANT: When removing bearing from back plate,be extremely careful to not damage machined surfaces.



3. Inspect the bronze side of the valve plate for ear,Replace the valve plate if any wear,scoring,or scratches exist.
4.Inspect the piston block surface that makes contact with the valve plate. This surface should be smooth and free of deep scratches.
5.Check the piston movement in the piston block bore.If the pistons are sticky in the bores examine the bores for scoring or contamination.



6. Remove the pistons and spider assembly.
7.Examine the outside of the pistons for finish condition.They should not show wear or deep scratches.
8.inspect the piston shoes for a snug fit on the ball end of the pistons.Check the face of the shoes for a flat smooth surface.
9.Examine the spider for wear in the pivot area.
10.Examine the pivot to ensure smoothness and no signs of wear.

11.Inspect the cam washer shoe surface.It should be free of scratches and wear marks.

IMPORTANT: Piston face damage can be caused by towing unit,dry start-up, or loss of charge pressure.

Piston Block Disassembly:

NOTE: Disassembling the piston block assembly is not necessary unless the spring or pins are damaged.

⚠ CAUTION

The spring inside the piston block is pressed and should not be removed without compressing the spring first.Use the following procedure to remove the spring safely

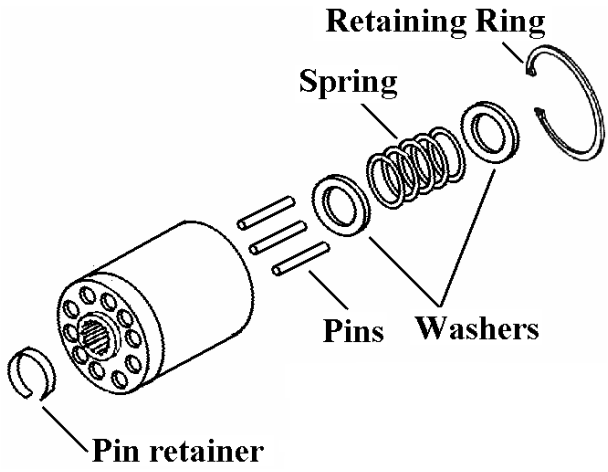
The following parts will be needed to disassemble the piston block.

2ea----------3/8 IDX1-1/4 in .OD flat washers.
1ea----------3/8X 5in.N.C. cap screw
1ea----------3/8 in .N.C.nut
1ea----------1/2 in.Drive Socket with 1-1/8 in.OD

12.Place one of the flat washers over the 3/8X5 in. cap screw through spline end of piston block so that the washer rests on the three pins.

13.place the socket and then the washer over the end of the cap screw.

14.Screw the nut on and slightly compress the spring inside the piston block.
15.Use retaining ring pliers to remove the internal retaining ring.
16.Carefully back off tension on nut until spring is slack.
17.Remove the nut,Washer,and cap screw.



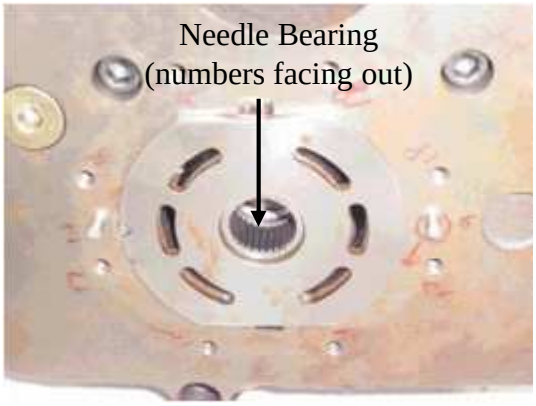
18.Remove washers,spring,pins,and pin retainer.
19.Inspect the spring inside the piston block for damage.Inspect pins for straightness.

8.HYDROSTATIC MOTOR ASSEMBLY

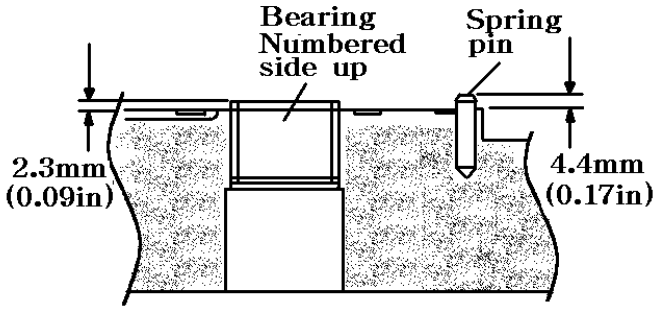
IMPORTANT: Due to extremely tight tolerances, and finish of internal surfaces,it is very important to maintain absolute cleanliness during the assembly of the motor.Coat all internal surfaces with clean 10W30 motor oil when assembly

Main shaft Bearing Installation:

Note: All needle bearings are pressed in with numbers facing out.

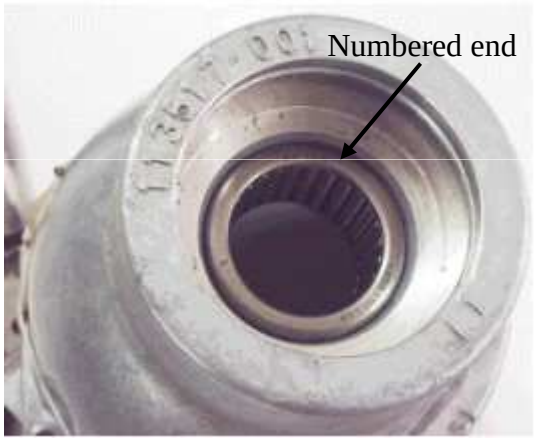


1. If the bearings were removed from the back plate, a new one can be pressed in,Numbers up,using the correct size bearing driver. The back plate bearing should be pressed in until 2.3±0.2 mm (0.09in ±0.010in) is left above the bore.



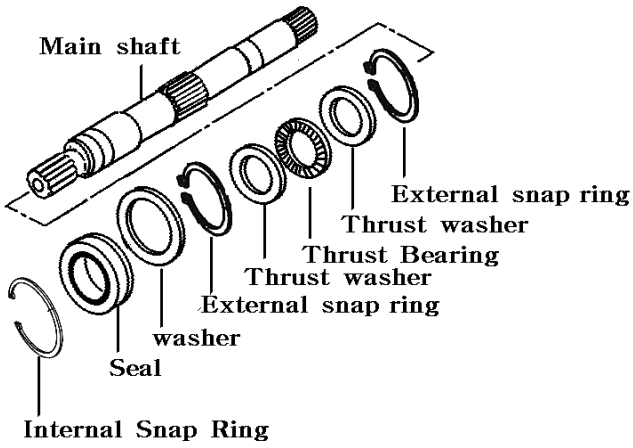
2. If spring pin that is used to position the valve plate was removed or damaged,install a new one.Allow the pin to protrude from the back plate approximately 4.4mm(0.17 in)

Cam plate and shaft Installation



3.The housing bearing should be pressed on the numbered side,from the outside of the housing inward.Until the numbered end is recessed 2.0mm ±0.3mm(0.078±0.015in) in the housing bore.

4.Apply some grease to the “THIS SIDE DOWN” side of the cam washer before installing into motor housing so it will stay in place while installing rotating assembly.

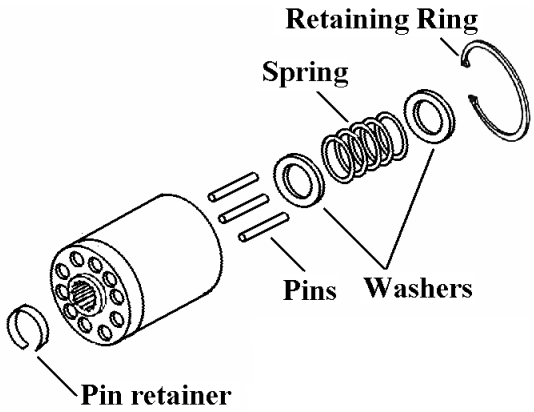


5.Install the inside snap ring,thrust washer,and thrust bearing on shaft.Install the outside thrust washer and snap ring.

6.Install the shaft into the housing.Install the washer and the new shaft seal.Secure them with the retaining ring.

Rotating Unit Assembly and Installation:

1.If the piston block assembly was disassembled complete the following. If not , skip to step 10.



2.Install the three pins in oversize grooves in spline end of piston block with the heads facing inside of the block.

3.Install the pin retainer.

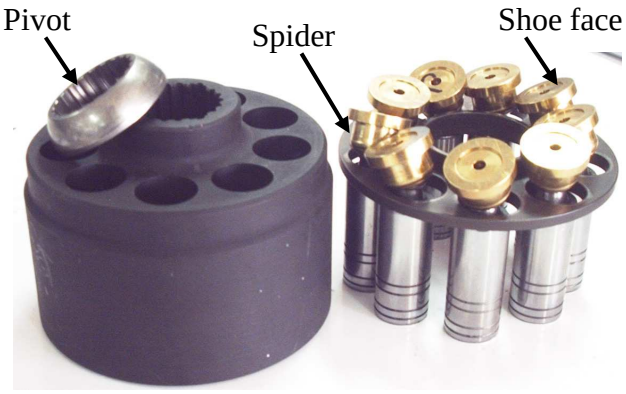
4.install the washers and spring.

5.Using same tools used to compress spring during disassembly of block install washer, spring,second washer,cap screw and nut in the piston block.

6.Compress spring.

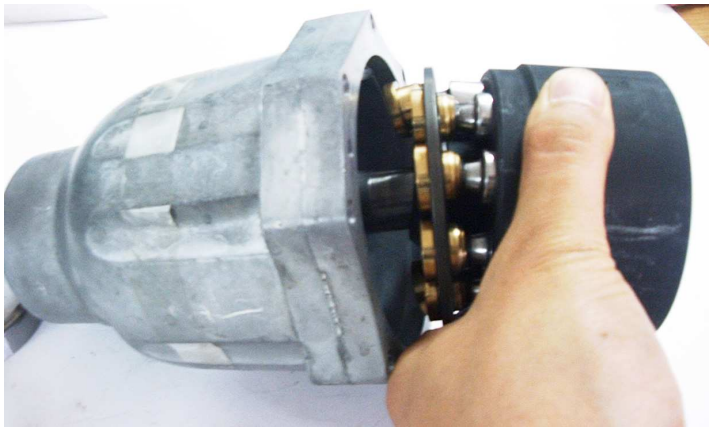
7.Install retaining ring.

8.Remove spring compression tools from the piston block

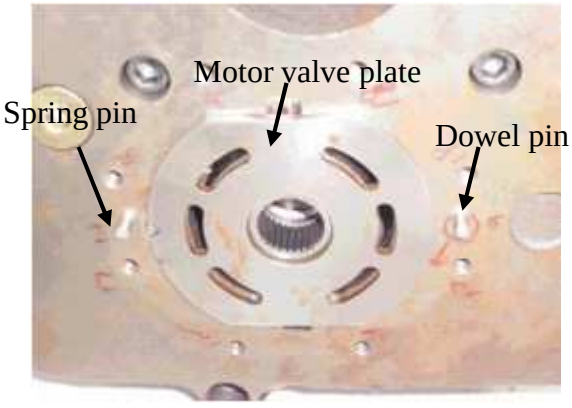


9.place an appropriate size socket in the hole in the piston block to keep the pivot in place while installing the pistons.
10.With the pistons in place in the spider, lower the pistons into the piston block.

NOTE:It is not necessary to put the pistons in the original position.Any piston can be installed in any hole.



11.Tilt the motor housing so that the open end is facing slightly downward.
12.Slide the rotating unit up the shaft until it meshes with the splines on the shaft.



13.if removed,install the spring pin in the back plate used to retain the valve plate. Allow the pin to protrude from the back plate approximately 4.4mm(0.17 in)
14.If removed, install two dowel pins.
15.Apply a small amount of grease to the steel side of valve plate to hold it in place for installation.Place the valve plate in position on the back plate with steel side against back plate.

IMPORTANT: Install motor housing with cam plate slope marking as shown. If installed incorrectly the tractor will go backwards when forward pedal in depressed.

16.install the motor assembly onto the back plate assembly with the cam plate marking as shown.
Make sure that the valve plate and cam washer stay in position.

IMPORTANT: Damage to pump may occur if retaining cap screws are not tightened evenly,and in a criss-crossing pattern to keep pump mounting flange and back plate parallel.

17.install eight socket head cap screws to retain motor to back plate.Tighten evenly in a criss-crossing pattern so that pump mounting flange and back plate remain parallel.Tighten to 10-14N.m (87-123lb-in).

CHAPTER 5
Transmission

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2.PTO drive system ----------5-1
3.Power train diagrams ----------5-1

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Chapter 5 .Transmission

SECTION 1.GENERAL DESCRIPTION

1. WHEEL DRIVE SYSTEM

The wheel driving system is composed of the following major components:

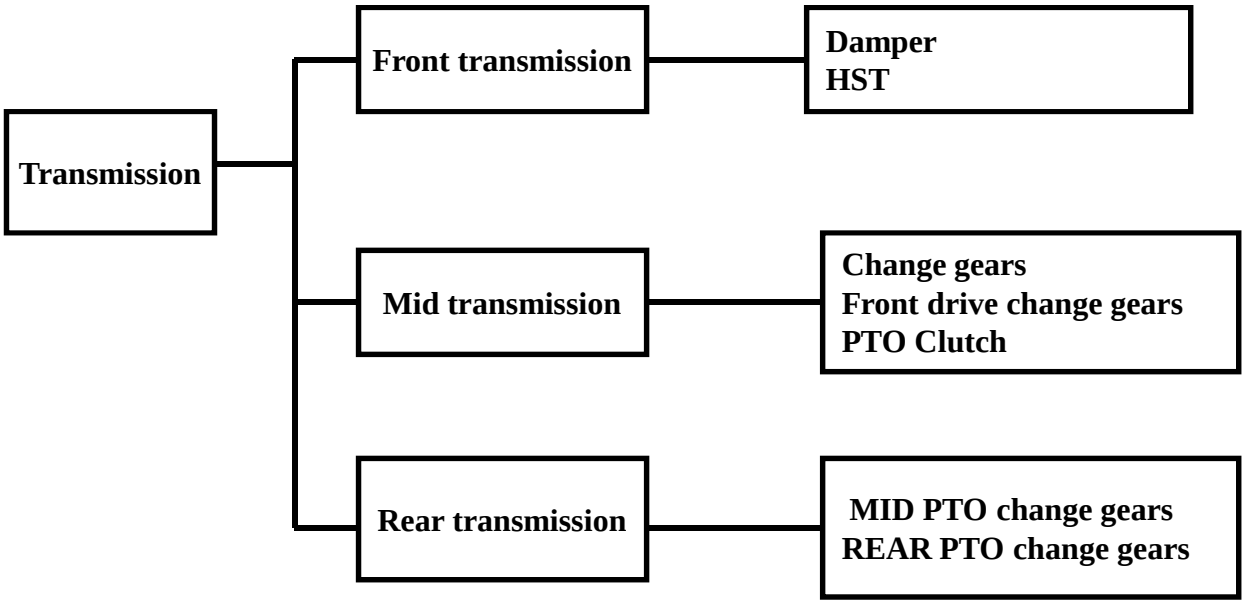


Fig.5-1 Wheel drive system

2. PTO DRIVE SYSTEM

(1) PTO drive system is composed of the hydraulic clutch and the PTO change gears.

(2) PTO drive system is composed of MID PTO and REAR PTO,which is referred

POWER TRAIN DIAGRAMS.

3. POWER TRAIN DIAGRAMS

Refer to page 5-38 at the end of this chapter.

SECTION 2. SPECIFICATIONS

1. WHEEL DRIVE SYSTEM

		T303HST/T353HST	
Speed shift range		Engine rated rpm: 2800 rpm	
Reduction ratio	Main speed shift	HST	
	Speed range shift	L(Low) M(Mid) H(High)	0.3250 (13/40) 0.6061 (20/33) 1.3182 (29/22)
	Drive pinion-Wheel gear		0.0363 (10/51*10/54)
Operation methods	Main speed shift		Pedal - RH
	Speed range shift		Side shift - LH
Oil capacity	Transmission case	Recommended Oil	THF500
		Capacity	35 ℓ

2) PTO DRIVE SYSTEM

MODEL		T303HST/T353HST
TYPE		INDEPENDANT
CLUTCH		Multiple Wet Disk
Rear PTO	Speed shift range	1
	Reduction ratio	0.1946
	PTO shaft speed	540 @ Engine 2,775rpm
	PTO shaft size	Φ35 mm, 6 straight splines
	Rotation direction	CW viewed from the rear
Mid PTO	Speed shift range	1
	Reduction ratio	0.7546
	PTO shaft speed	2000 @ Engine 2,650rpm
	PTO shaft size	Φ25 mm, 10 straight splines
	Rotation direction	CW viewed from the rear
PTO clutch	Type	Wet,multi-disc,hydraulic-operated clutch
	Number of clutch plates	6
	Used oil	THF500 (In common with transmission oil)

SECTION 3. DISASSEMBLY,INSPECTION,AND REASSEMBLY

1.HST system and change gears (front transmission).

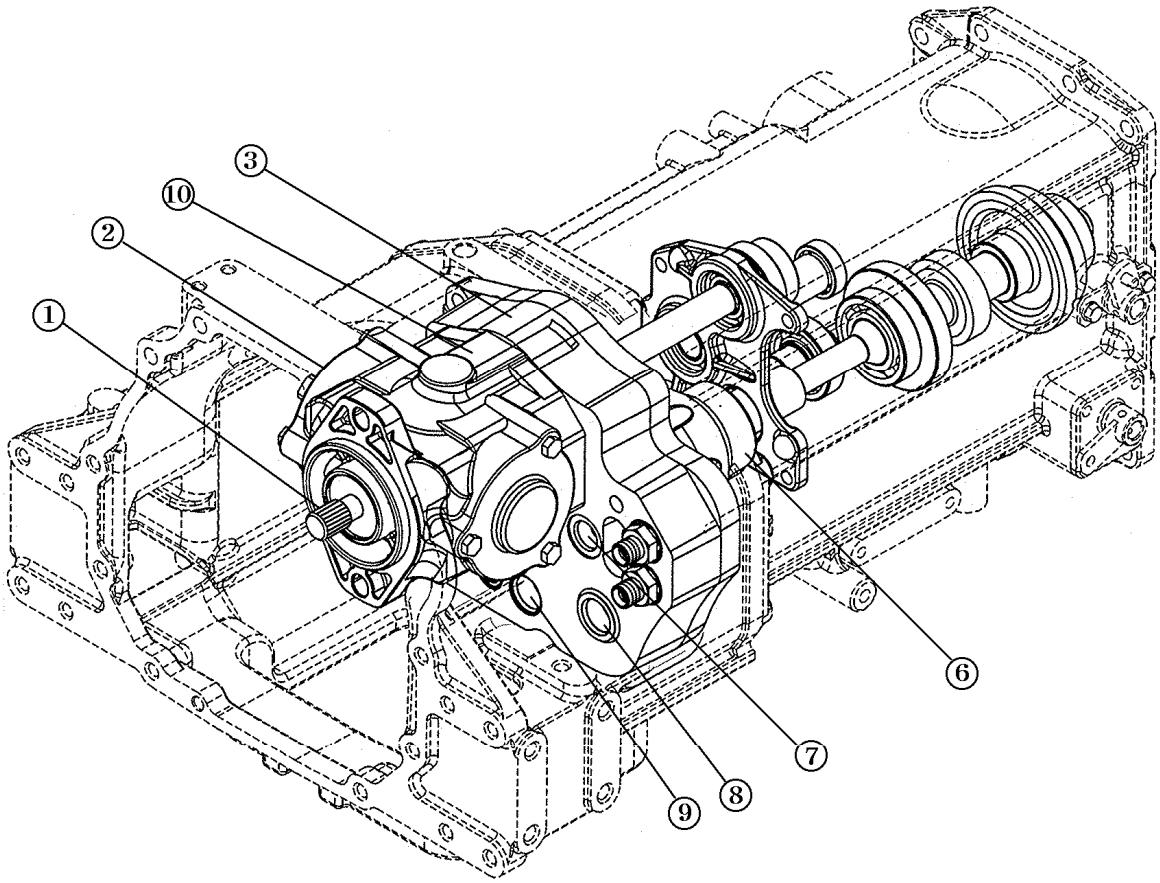
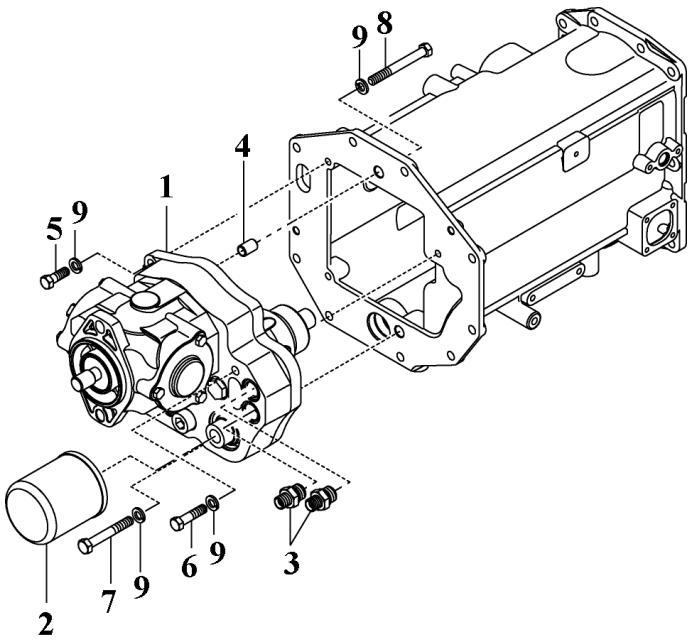


Fig.5-2

1. Input shaft From engine
2. Control Lever
3. Back Plate
4.Hydrostatic Motor
7. Charge pressure relief Valve
8. Filter mount port
9. For,&Rev.Relief valves
10. Hydrostatic pump

1.1 Disassembly.

(1) Removal of HST system and related parts.
Separate the engine from the front transmission referring to the paragraph of SECTION 7. REPAIR in CHAPTER 4.



1.HST Unit

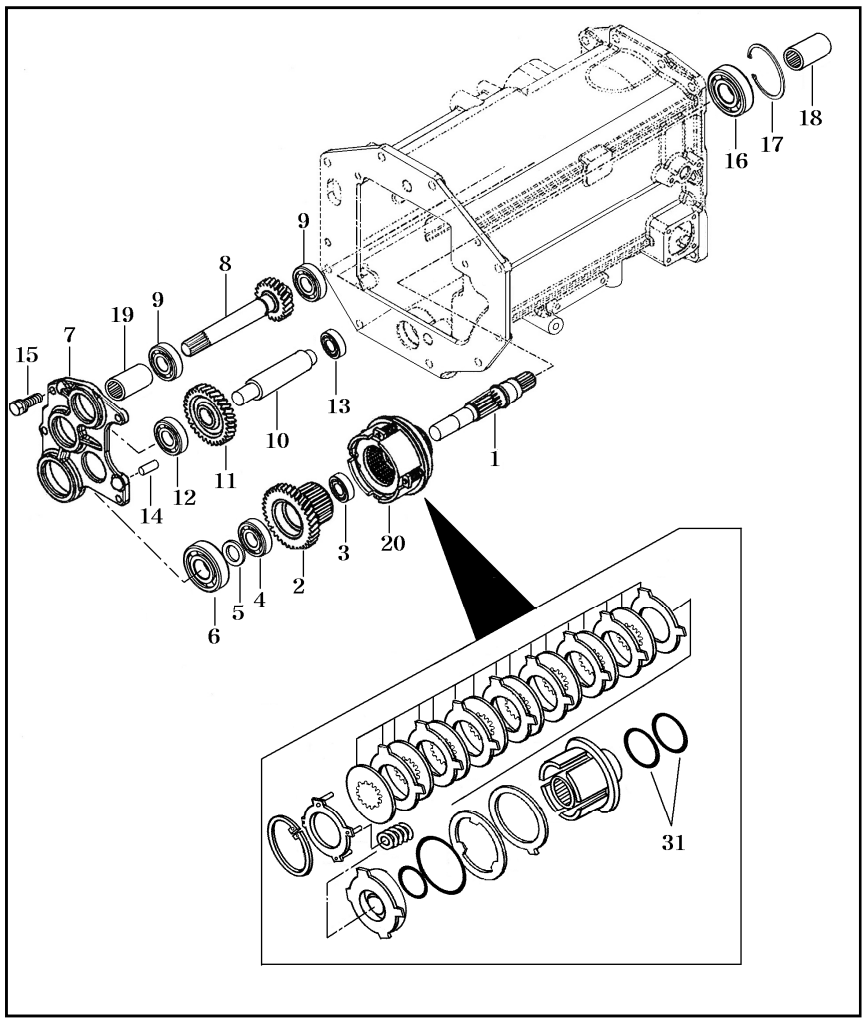
2.Hydraulic filter

3.Valve

4.Pin,hollow

5.6.7.8.9 Bolt, hex

Fig.5-3



1.Shaft PTO Clutch
2.Gear,helical 35T
3.Bearing,Ball
4.Bearing,Ball
5.Collar,26X35X03
6.Bearing,Ball
7.Metal,Bearing
8.Gear,Helical 21T
9.Bearing,Ball
10.Shaft,PTO drive counter
11.Gear,helical 32T
12.Bearing,Ball
13.Bearing,Ball
14.pin
15.Bolt
16.Coupling 50
17.Bearing,Ball
18.C-ring 36X62
19.Coupling,36X62
20.Clutch, PTO Clutch
31.Seal set,B

Fig.5-4

1-2. REASSEMBLY

Reassemble them in reverse order of disassembly in accordance with the following instruction.

- Installation of clutch damper and related parts.

(1) When installing the clutch damper on the flywheel,be sure to install the cotter pin to flywheel.

(2) Apply a thin coat of molybdenum disulfide-based grease(Three bond TB1901 or equivalent) to revolving or sliding parts prior to reassembly.

(3) When installing the clutch damper on the flywheel,take care not to damage this clutch damper.

(4) Apply an ANTI RUST 720S or equivalent after installing clutch damper in order to prevent from rust.

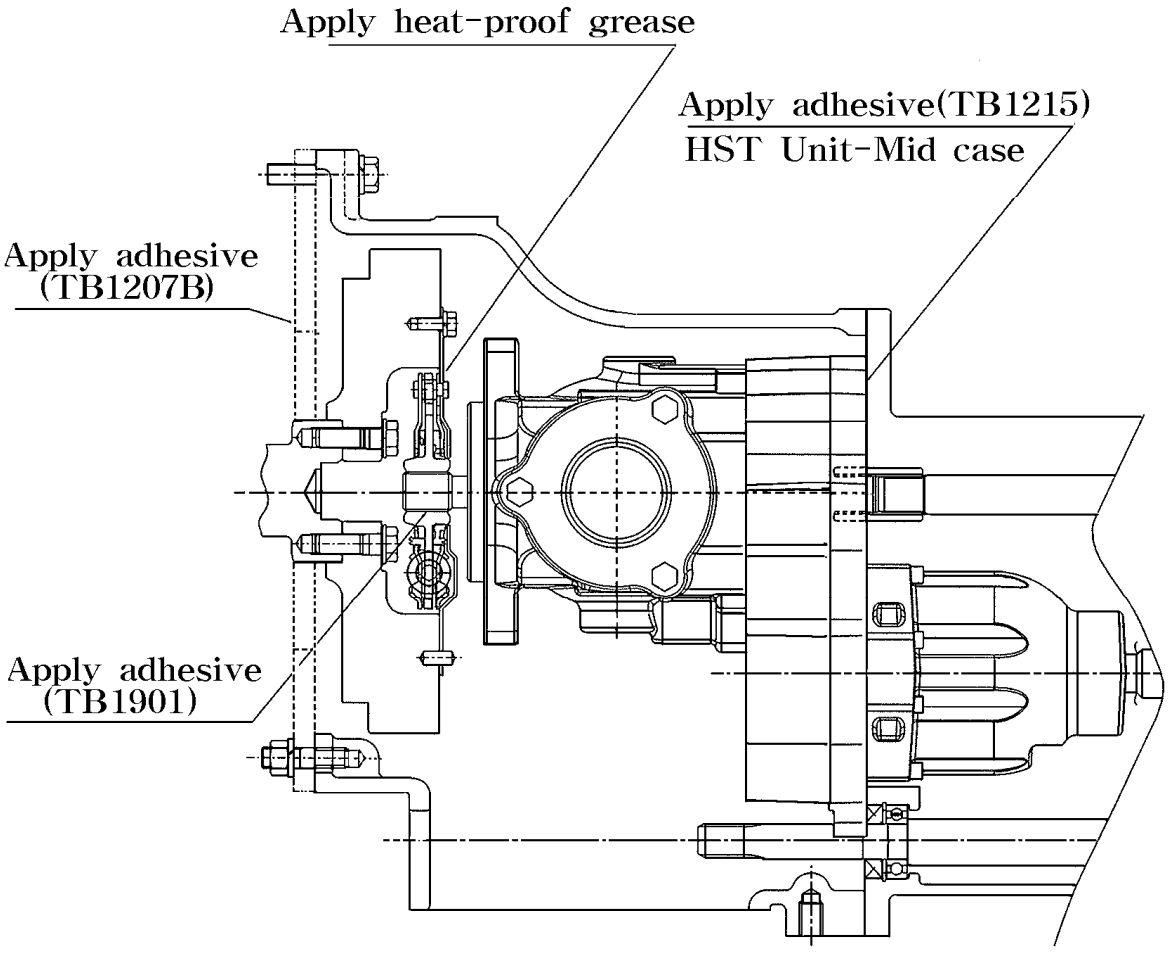
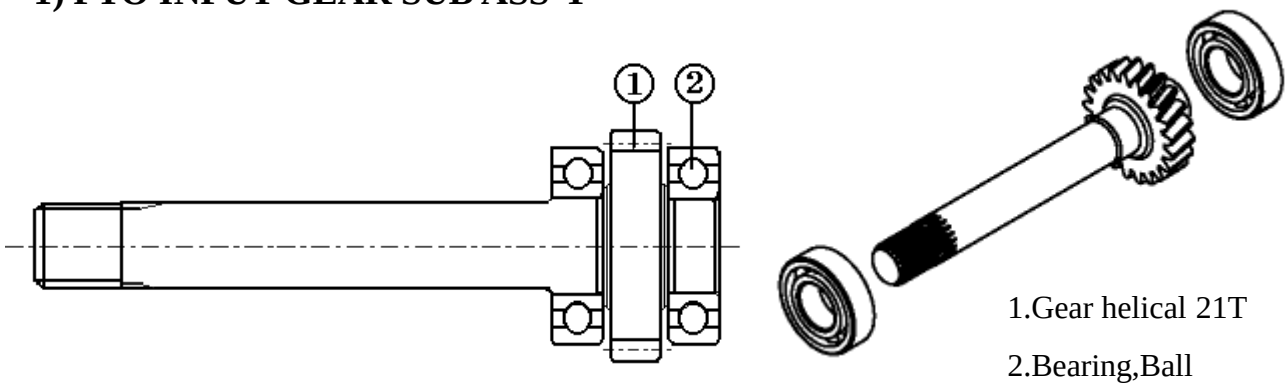


Fig.5-5

2. MID TRANSMISSION

1) PTO INPUT GEAR SUB ASS'Y



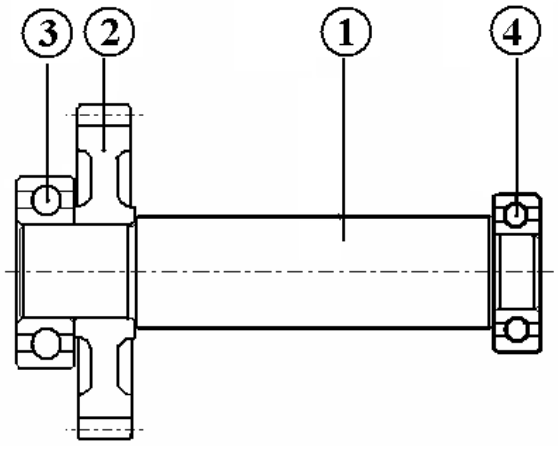
1.Gear helical 21T

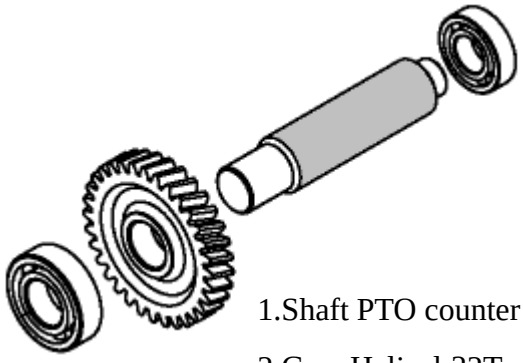
2.Bearing,Ball

Fig.5-6

(1) Pay attention to the direction of installation and check to see all the parts turns smoothly.
(2) When pushing the RBB's (6205)in to the gear,be careful only to push their inner races.
(3) When installing the PTO Clutch assembly,Apply a thin coat of grease to the seal rings and install it taking care not to damage these rings.
(4) When installing seal rings,Apply fresh oil ahead of time and install them carefully so as not to damage them.

2) PTO counter shaft comp





1.Shaft PTO counter

2.Gear,Helical 32T

3.Bearing Ball

4.Bearing,Ball

Fig.5-7

(1) When pushing the RBB's (6205)in to the gear,be careful only to push their inner races.

(2) Pay attention to the direction of installation and check to see all the parts turns smoothly.

3) PTO CLUTCH

(3-1) DISASSEMBLY

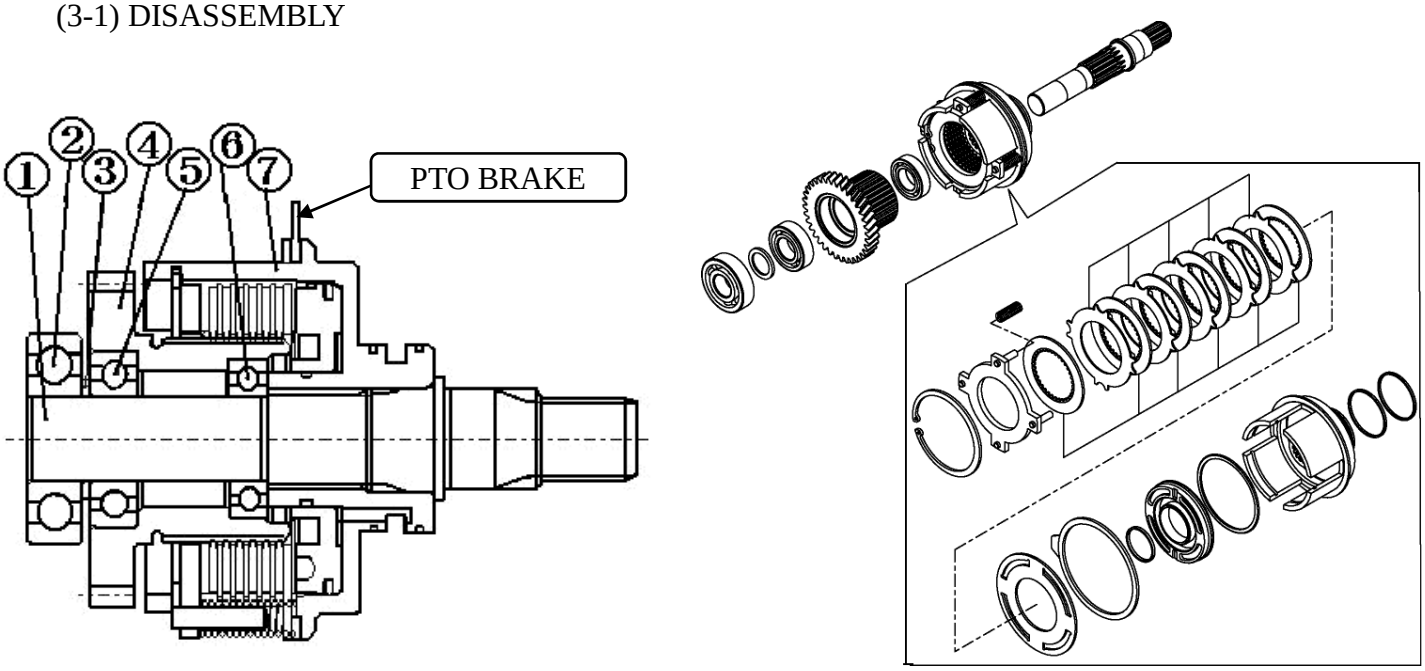


Fig.5-8

1.Shaft,PTO clutch 2.Bearing ball(6203) 3.Collar(26x35x03) 4.Bearing ball
5.Gear,helical 35T 6.Bearing,ball 7.Clutch ass'y PTO

Note:
Disassembly of the PTO clutch assembly should be done in a clean,dust-free place.Exercise special attention to avoid damage of the seal rings,etc

a. Pull out PTO drive shaft rearwards.
b.Pull out PTO drive gear forwards.
c.Remove snap ring (D95 for hole),and take bake-up plate,disc assembly,and driving plates.
d.While holding return spring(43) compressed with a special tool,remove snap ring

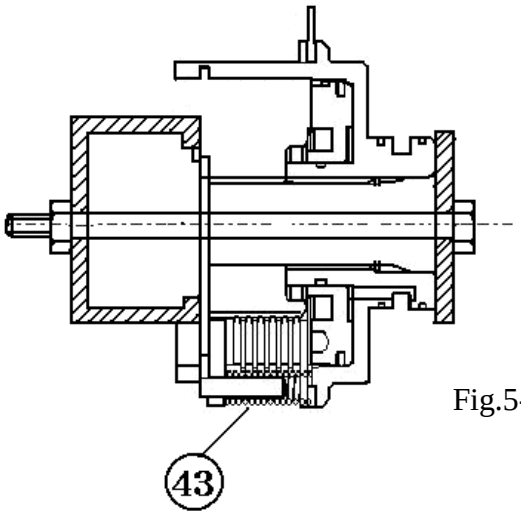


Fig.5-9

e. Disassemble into separate parts;piston,return sparing,brake disc,and cover assembly.

(3.2) INSPECTION

a. Cover assembly
-Replace a cover assembly which has a damaged or worn sliding surface.
-If there is any damage to the cover assembly and the piston seal ring,these parts should also be replaced.
b. Disc assembly
- If the thickness of a disc assembly exceeds the usable limit mentioned below or combined width of the disc assembly and driven plate is less than 23.8mm(0.937 in),replace both the disc assembly and driven plate.

-Inspection for disc thickness and serration wear.

Inspection Items	Specified values	Usable limit
Disc thickness	2.2±0.1mm (0.087 in)	1.9mm (0.075 in)
Surface flatness	-	0.2mm (0.008 in)

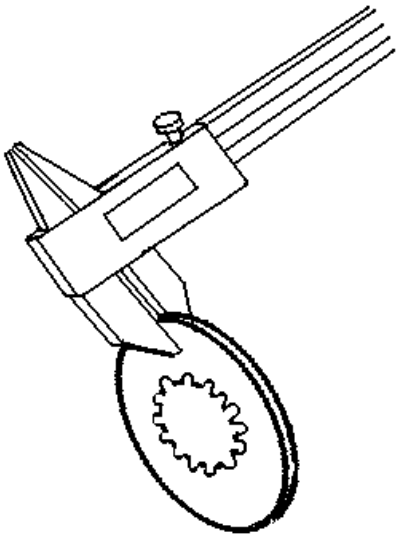


Fig.5-10

c. Driven plate
-Inspection for deformation and burning.
-A seriously damaged or worn disc should be replaced.

Inspection Items	Specified values	Usable limit
Surface flatness	-	0.2mm (0.008 in)

d. Brake disc
-Inspection for deformation and burning.
-A seriously damaged or worn disc should be replaced.

Inspection Items	Specified values	Usable limit
Disc thickness	3±0.1mm (0.118 in)	2.5 mm (0.098 in)
Surface flatness	-	0.2mm (0.008 in)

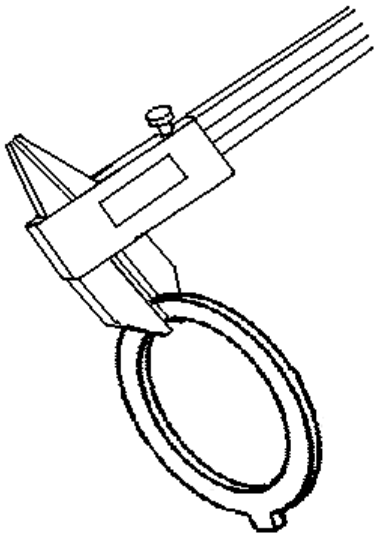


Fig.5-11

e. If the combined thickness of the return plate and brake disc deviates from the specified value, replace both parts.

Inspection Items	Specified values	Usable limit
Combined thickness of return plate and brake disc	5.5 ±0.18 (0.217 in)	5mm (0.2 in)

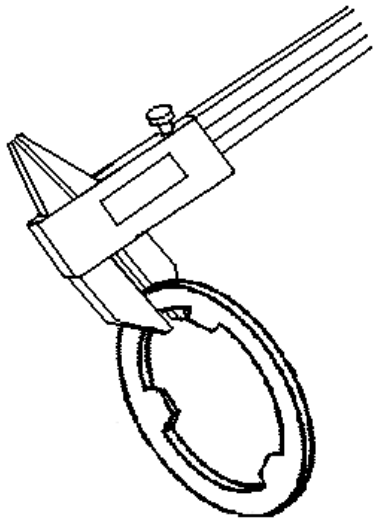
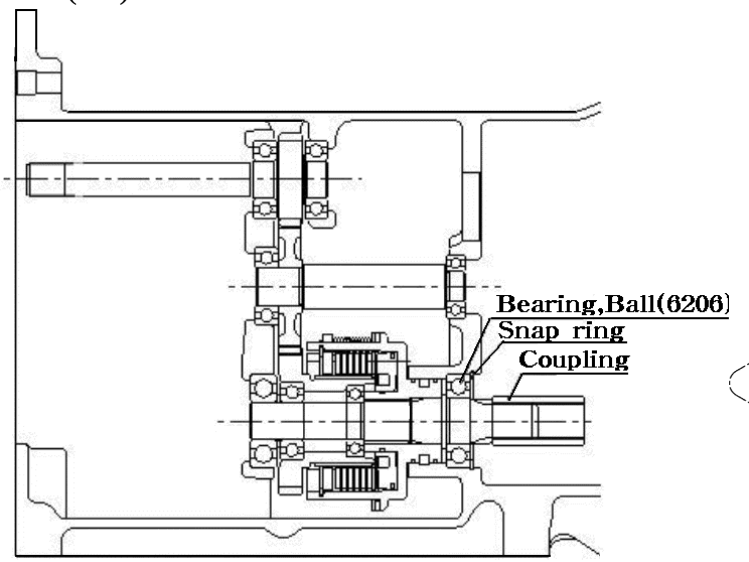


Fig.5-12

f. Also inspect other parts for wear and deformation and replace them if necessary

Note:
Seal ring and the two seal rings should be replaced as a pair

(3-3) REASSEMBLY



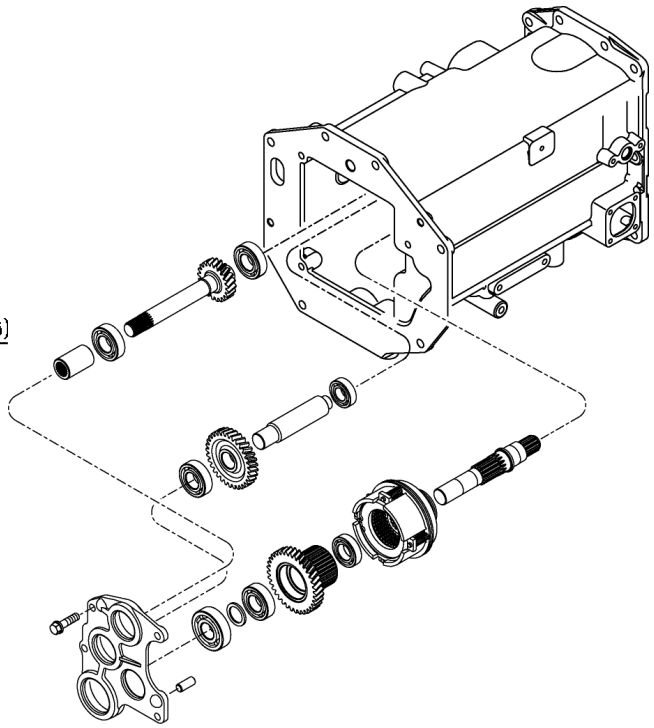


Fig.5-13

Reassemble the parts in reverse order of disassembly,following these instructions.

Note:
-Each parts should be washed clean before reassembly.
-Apply multi-purpose,quality grease to needle bearings in advance.
-Each bolt and nut should be tightened to the respective specified torque table.
-Every time a gear is installed,its smooth rotation should be checked.
-Every snap ring should be seated securely in its groove.

a. When installing seal rings, apply fresh oil ahead of time and install them carefully so as not to damage them.

b. Install the return plate with the press-processed side turn towards the brake disc.

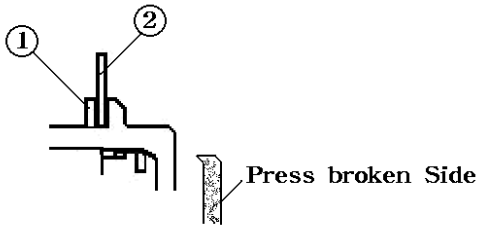


Fig.5-14
① Return plate ②Brake Disc

c. When installing the return spring,use a special tool; the snap ring should be securely seated in the groove.

d.When pushing the RBB's (6205 and 6005) into the gear,be careful only to push their outer races.

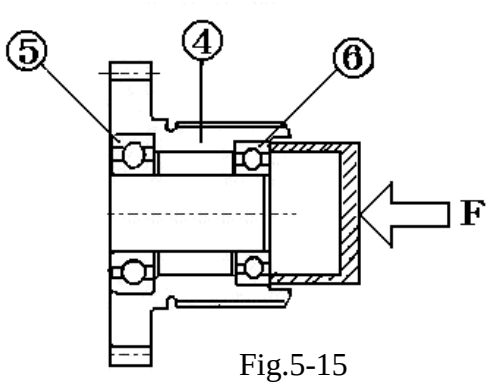


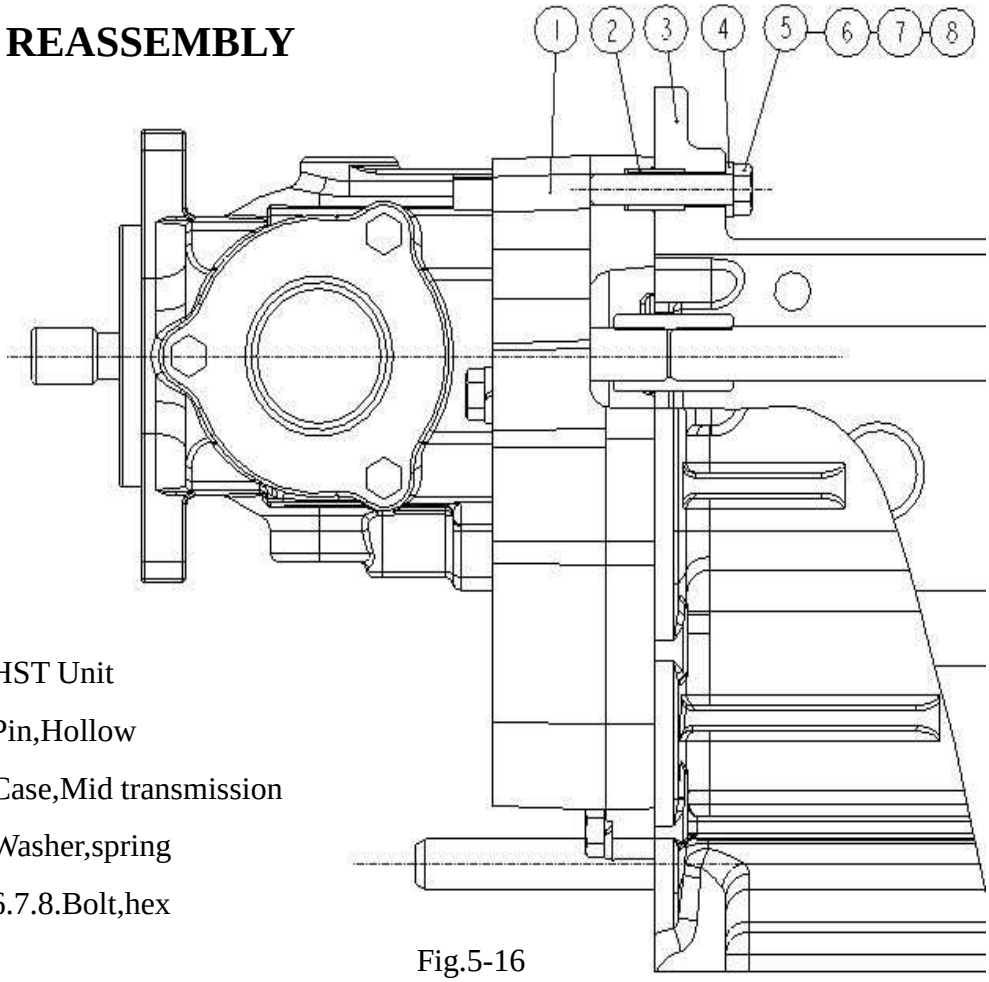
Fig.5-15

4.Bearing ball (6205) 5.Gear,helical 35T
6.Bearing,ball (6005)

e. Install washer in correct direction.

f. After reassembly,check to see that gear(35T) turns smoothly by locking the PTO clutch

4) HST REASSEMBLY



1.HST Unit

2.Pin,Hollow

3.Case,Mid transmission

4.Washer,spring

5.6.7.8.Bolt,hex

Fig.5-16

Reassemble them in reverse order of disassembly in accordance with the following instruction.

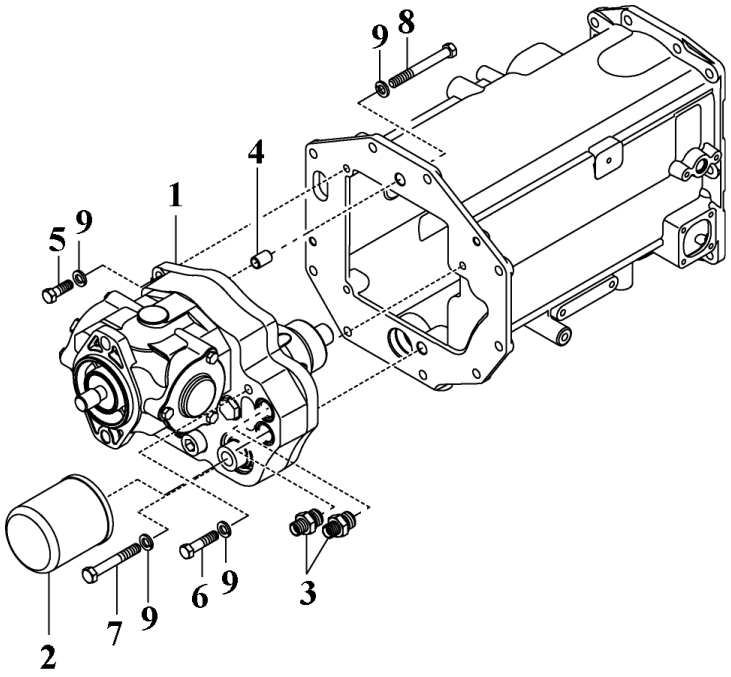
- Installation of clutch damper and related parts.

(1) When installing the clutch damper on the flywheel ,be sure to install the cotter pin to flywheel.

(2) Apply a thin coat of molybdenum disulfide-based grease(Three bond TB1901 or equivalent) to revolving or sliding parts prior to reassembly.

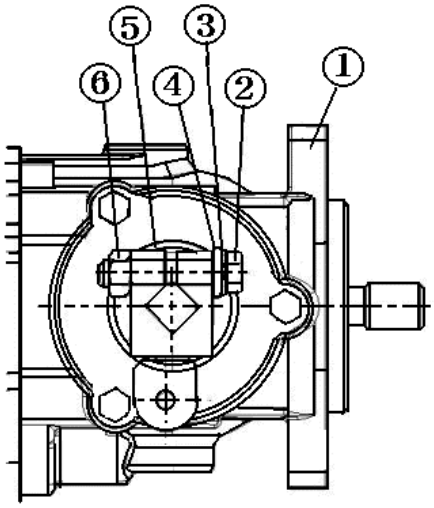
(3) When installing the clutch damper on the flywheel, take care not to damage this clutch damper.

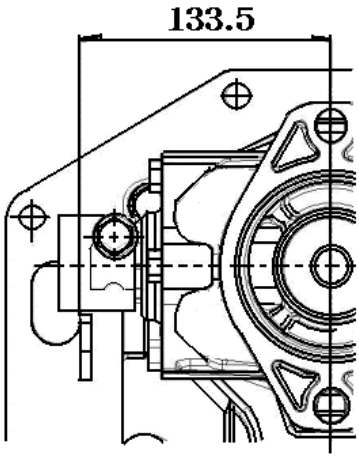
(4) Apply an ANTI RUST 720S or equivalent after installing clutch damper in order to prevent from rust.



(4-1). Forward and reverse

1) HST holder comp





1.HST Unit 2.Bolt 3.Washer spring
4.Washer plain 5.Holder comp
6.Nut

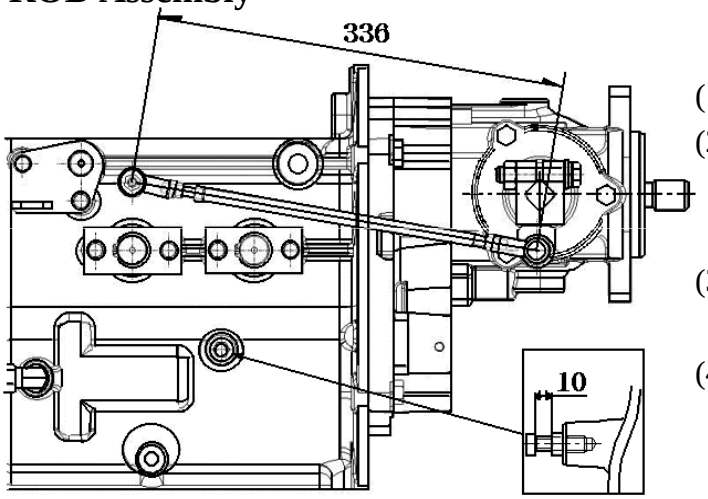
(1) When reassembling holder comp, take care directions.

(2) After installing holder comp,be sure not to skip the parts.

Fig.5-17

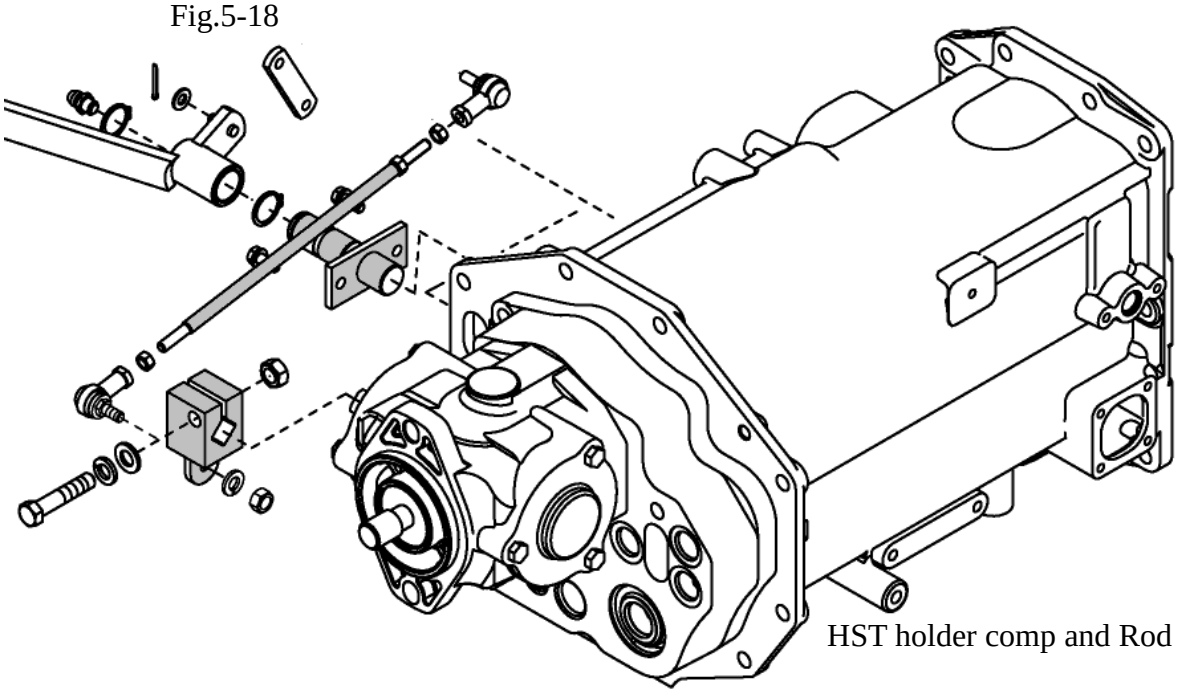
2) ROD Assembly

2) ROD Assembly



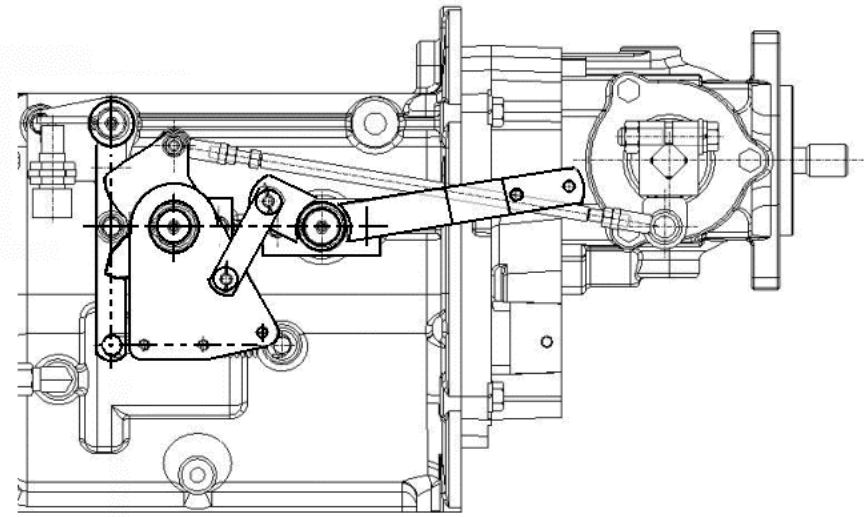
(1) Install the pin on Mid transmission case.
(2)Assemble the bolts and Nuts on Mid transmission case. Gap between bolt and nut is 10mm.
(3) Elbow between Mid transmission case and holder should be different direction.
(4) When assembling the Rod comp. It should go through the hole.

Fig.5-18



HST holder comp and Rod assembly

3) Forward and reverse arm assembly



(1)when assembling the forward and reverse arm to pin ,be sure to apply grease.

(2) Snap ring should be seated securely in it's groove with the press-processed side turned towards the outer side.

(3) Full grease after assembling the nipple.

Fig.5-19

4) CAM COMP

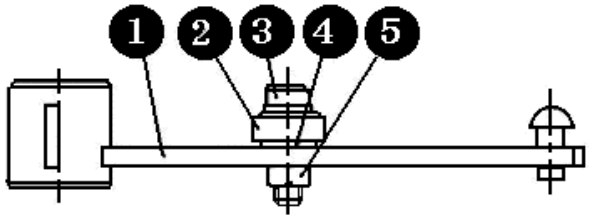
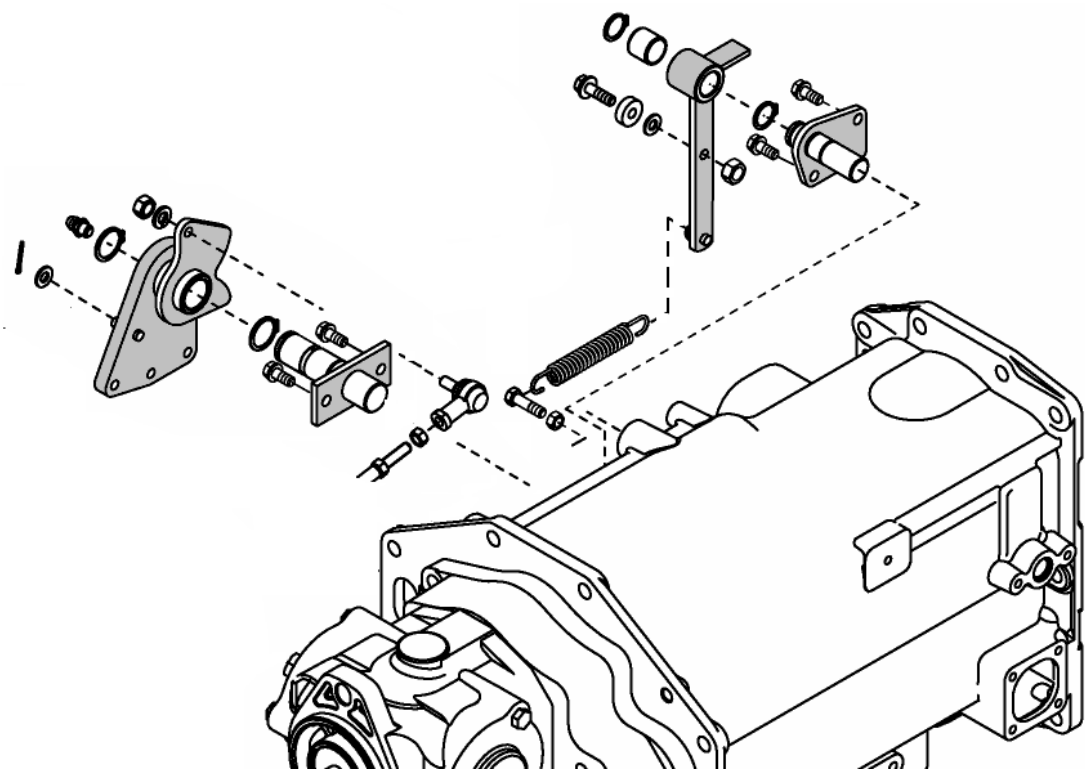


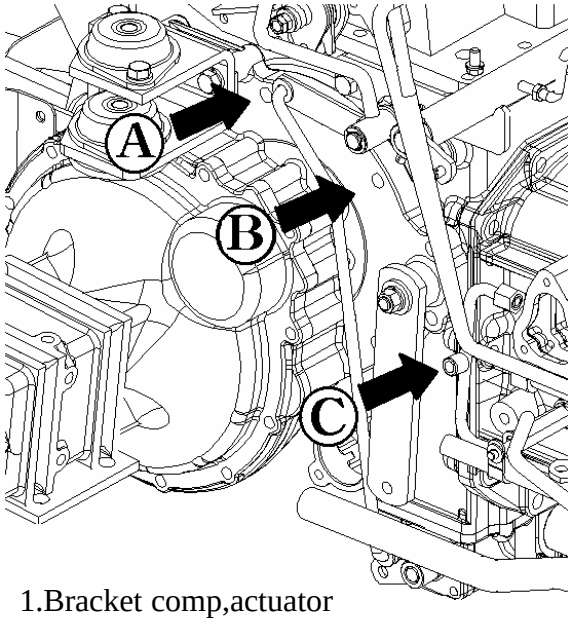
Fig.5-20

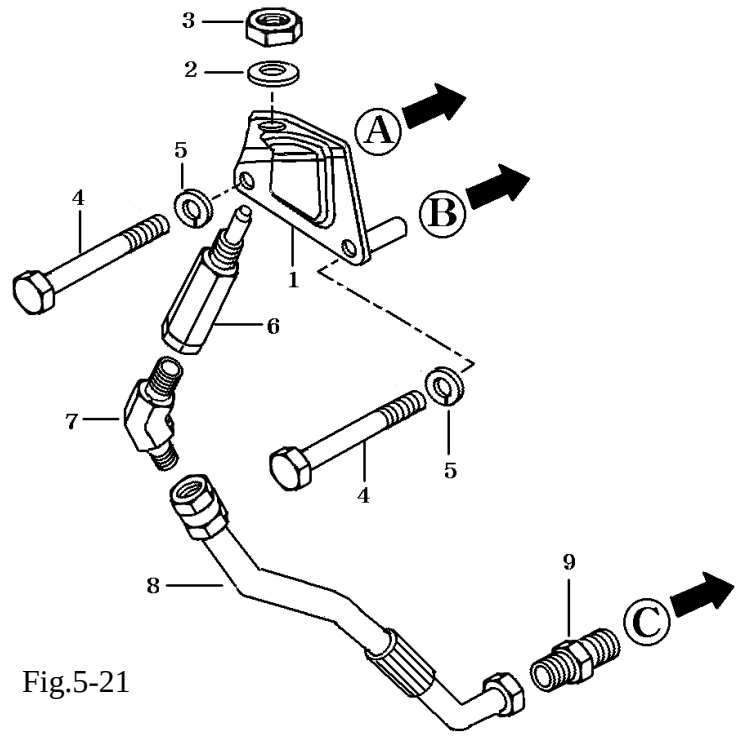
1.Arm comp 2.Bearing(608) 3. Bolt
4.Washer plain 5.Nut

(1) Install Ball bearing carefully so as not to damage to them.
(2) Install the switch on the Pin.
(3) When assembling the cam comp to the pin ,be sure to apply grease.
(4) Snap ring should be seated securely in it's groove with the press-processed side turned towards the outer side
(5) Full grease after assembling the nipple.
(6) Be sure to check the spring has enough tension.



5) MID PTO STOPPER ASSEMBLY

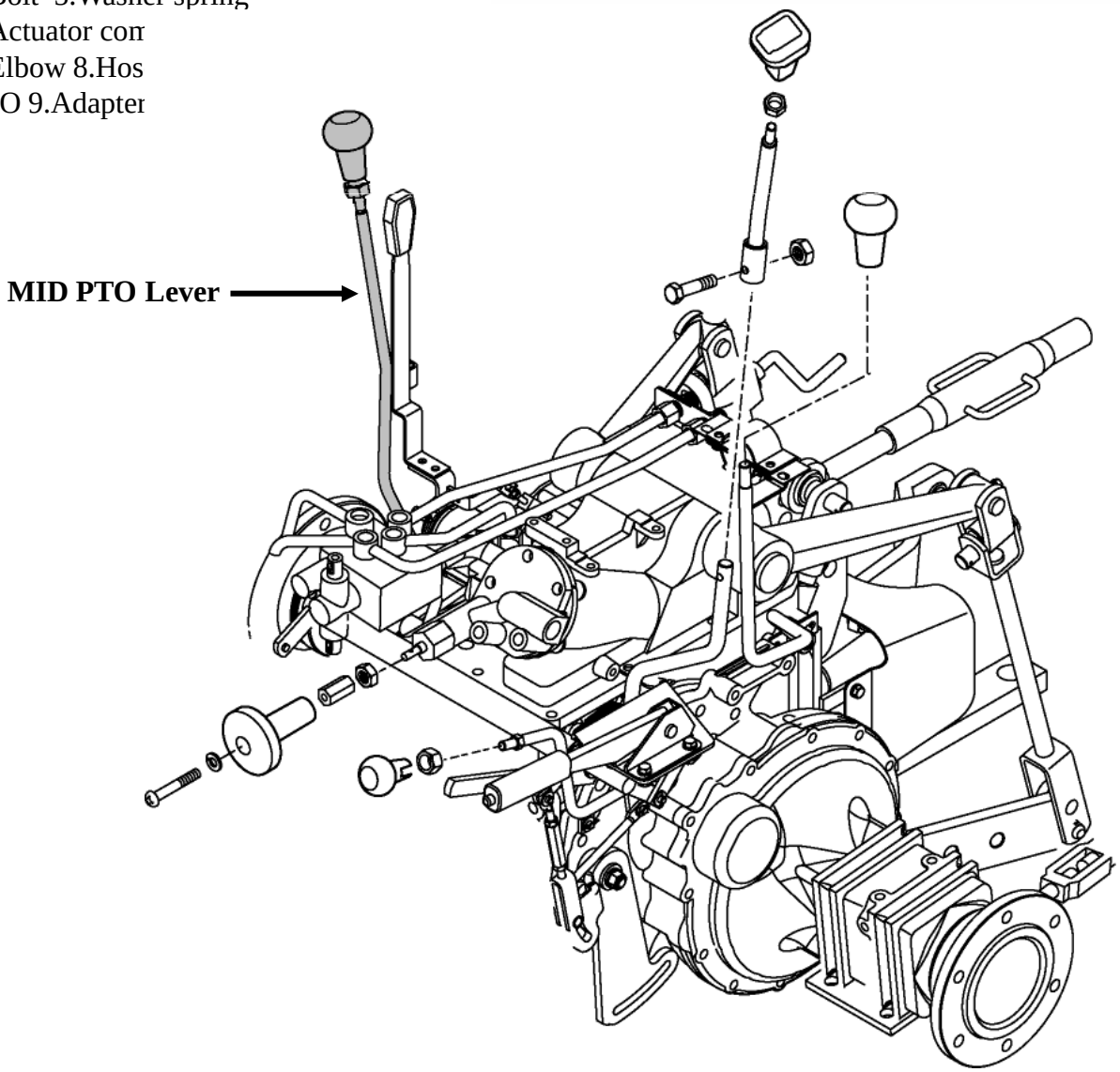




1.Bracket comp,actuator
2.Washer spring 3. Nut
4.Bolt 5.Washer spring
6.Actuator con
7.Elbow 8.Hos
PTO 9.Adapter

Fig.5-21

MID PTO Lever



6) MID PTO STOPPER OPERATION

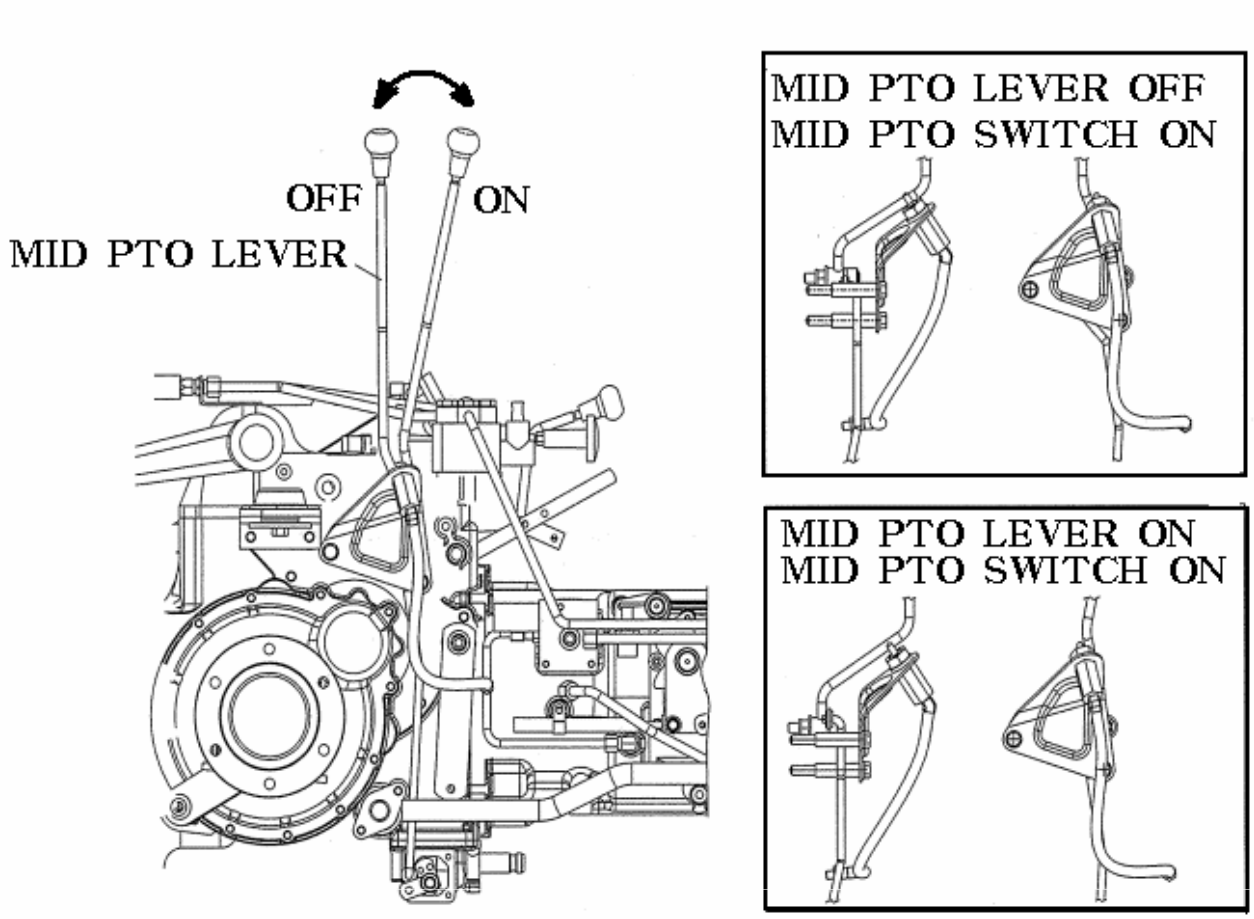


Fig.5-22

① When PTO switch is ON at engine works,The hydraulic fluid of PTO Valve flows to PTO clutch through hydraulic pipe,and let PTO shaft rotate which is engaged to Gear(16/23).

② The fluid flows to actuator and piston operates to protrude.

③ If MID PTO lever is ON before MID PTO switch is ON position,It is normal operation and if MID PTO is to be stopped,MID PTO switch must be OFF position.

④ The PTO switch must be OFF before PTO is engaged.

(Normal process : Engage MID PTO lever to ON -> MID PTO switch ON)

- The speed of MID PTO is 2,000 rpm.Use the mid PTO lever to engage.
- Decrease engine speed to near idle.
- Make sure that PTO switch is OFF
- If operator turns off PTO switch,Rear PTO and Mid PTO are off at once.

CAUTION	Do not operate any implement at a high speed than is specified for it. When making adjustments to the implement, stop the engine to avoid serious injury. When remove the Key. Set the parking brake

3. Rear transmission case

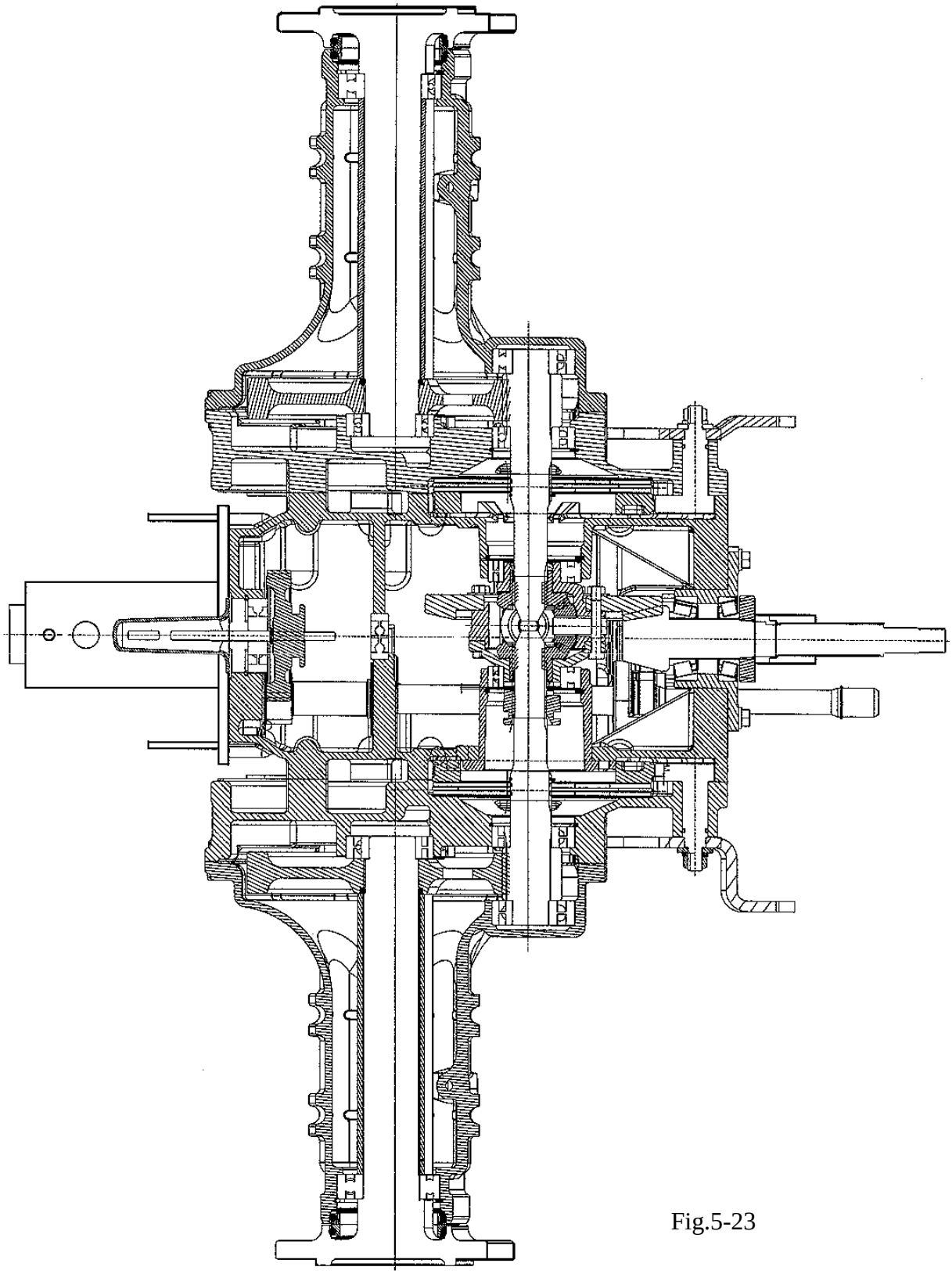


Fig.5-23

3-1. DISASSEMBLY

Separate the spacer transmission and the rear transmission from each other and then remove the hydraulic cylinder case.referring to paragraph 7**.(1) of SECTION 4. SEPARATION OF MAJOR COMPONENTS in Chapter 2.**

(1) Ring gear,Drive pinion,and related parts.

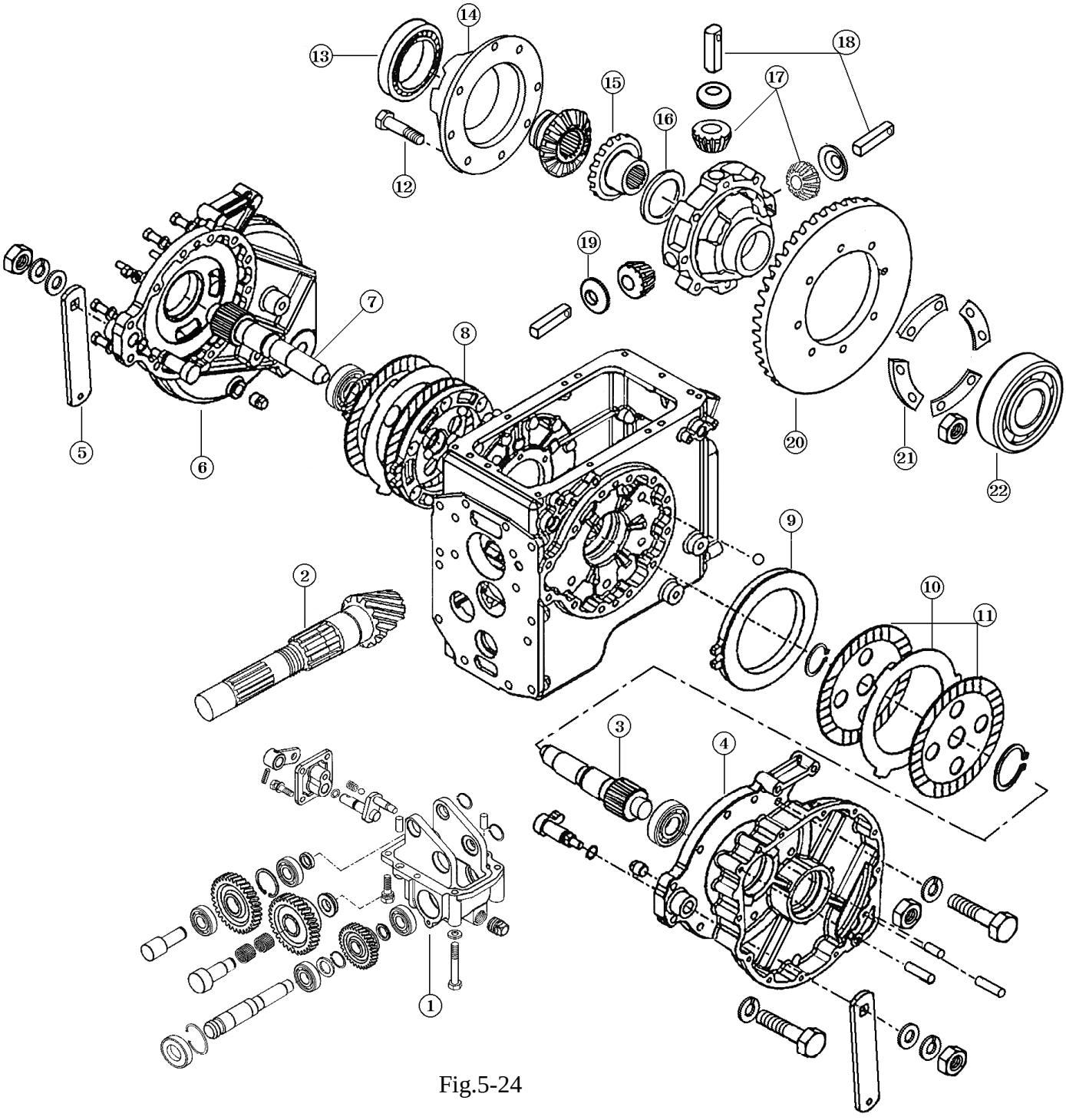


Fig.5-24

1.Mid PTO case 2 Pinion,drive 10 3. Pinion,wheel 10LH 4. Case Brake LH 5.Arm,brake
6.Case brake 7.Pinion,wheel 10RH 8.Metal brake RH 9.Metal brake LH 10.Plate,separate
11. Plate,brake 12.Bolt,Diff 13.R.B.B(6011) 14.Case RH Diff 15.Gear,bevel 20T
16.Collar 17.Pinion Diff12 18.Shaft,pinion,Diff 19.Collar 20.Gear bevel 51
21. Plate,lock 22. R.B.B(6011)

a. Disconnect Mid PTO case by loosening bolts as shown in Fig.5-25

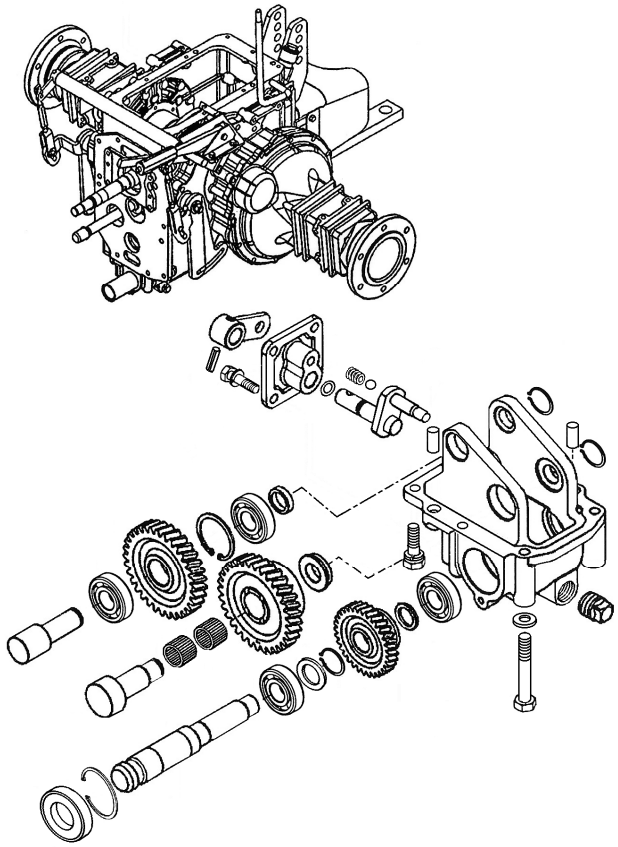


Fig. 5-25 MID PTO Case

b. Disconnect Case Brake LH and Case Brake RH by loosening bolts as shown in Fig.

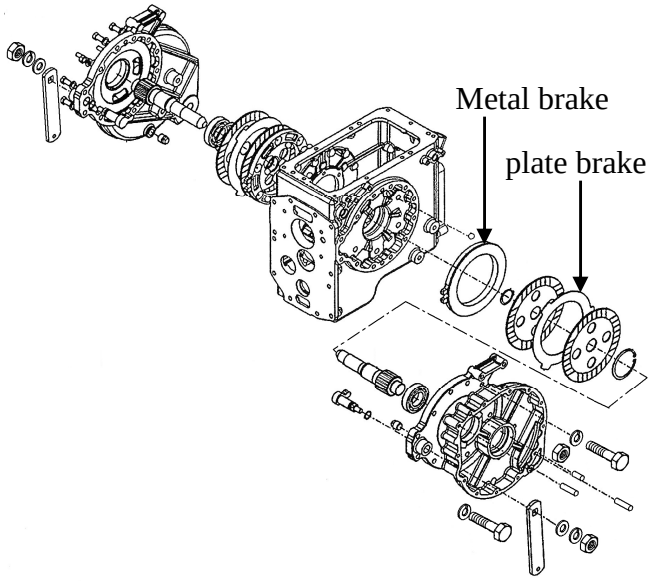


Fig. 5-26

c. Remove metal brake and plate brake as a set
d. Remove ring gear(2) as a set.
e.When disassembling the ring gear set further, remove bearing(22) with a puller.

f. Pull out diff pinion shaft(18) and take out dif-pinions(17) and dif-side gears(15).
g. Remove the pinion metal(support) tightening bolts and take put drive pinion and related parts as an assembly.The number of installed shims should be written down or memorized for later reference.

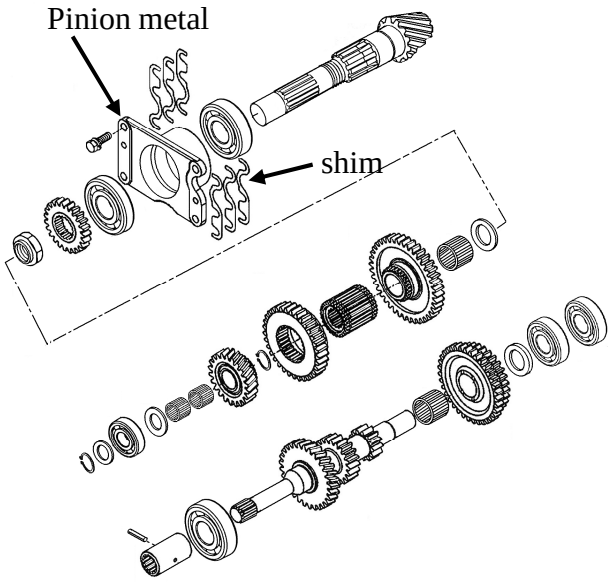


Fig.5-27

h. Release the lock of nut and remove the nut

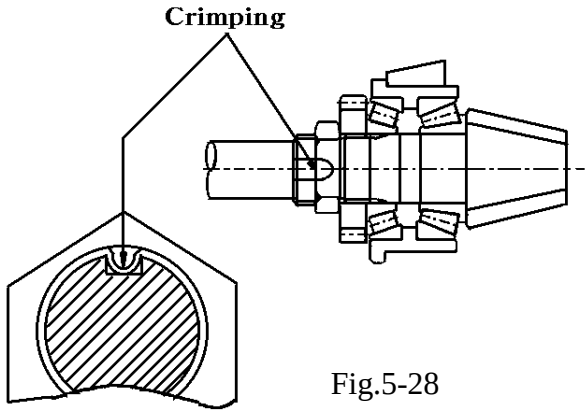


Fig.5-28

i.Push out drive pinion(2) from drive pinion metal on a press.
j.Remove the bearing from the drive pinion with a special tool.

(2) PTO shaft and related parts.

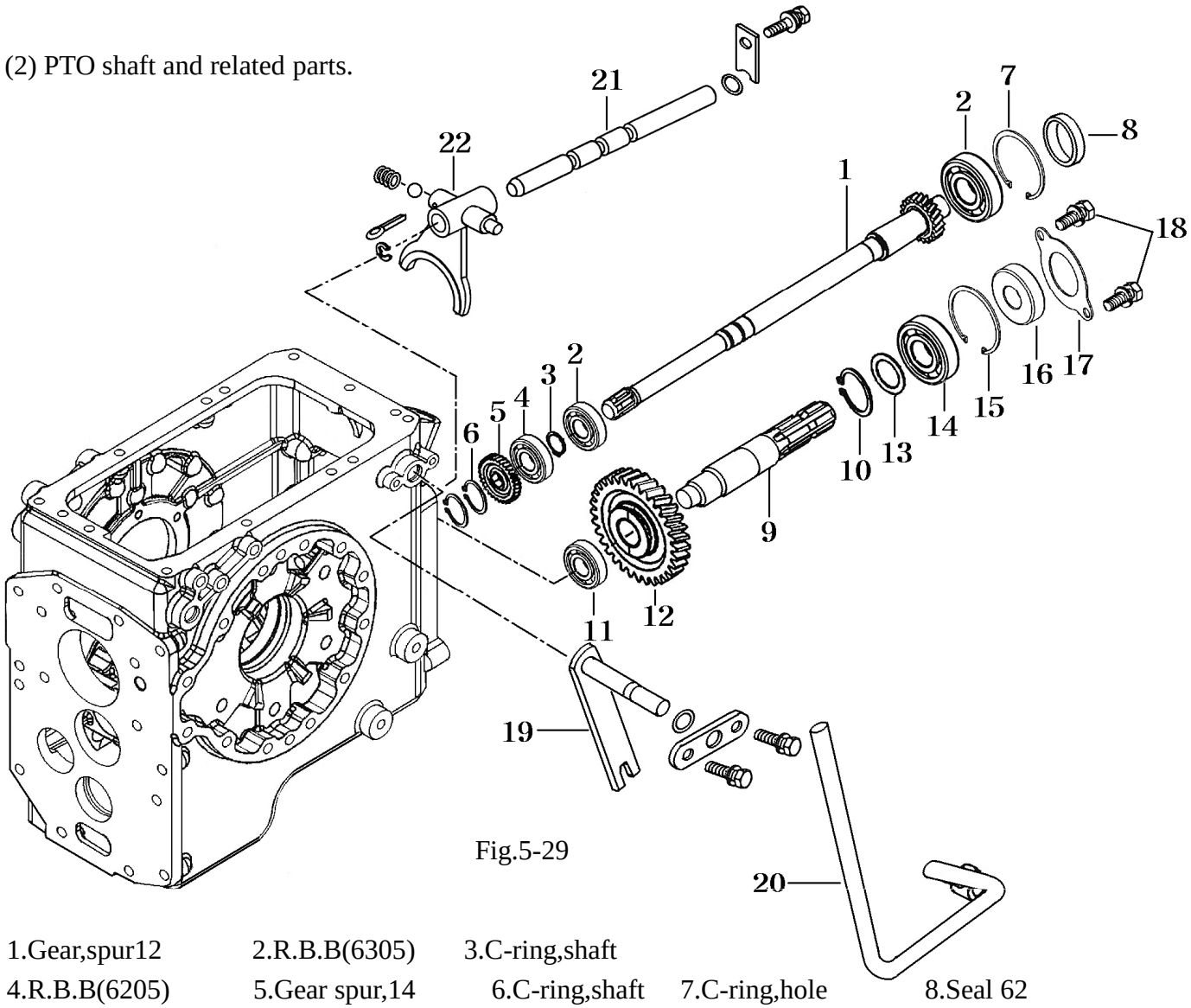


Fig.5-29

1.Gear,spur12 2.R.B.B(6305) 3.C-ring,shaft
4.R.B.B(6205) 5.Gear spur,14 6.C-ring,shaft 7.C-ring,hole 8.Seal 62
9.Shaft,PTO 10.C-ring,shaft 11.R.B.B(6205) 12.Gear,spur 37 13.Collar(35X50X2)
14.R.B.B(6207) 15.C-ring(hole) 16.Oil seal 17.Cover 18.Bolt
19.Hook,rear PTO 20.Lever,rear PTO 21.Stay,PTO shift 22.Shifter,PTO Low speed

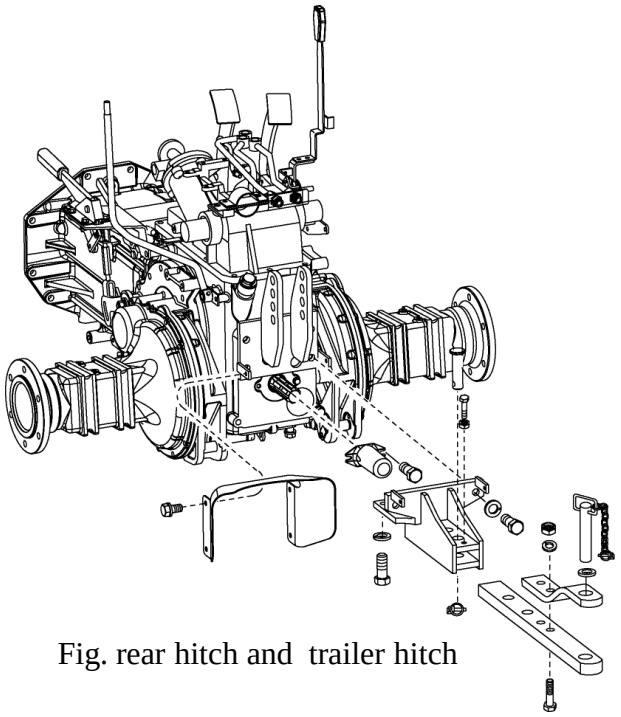


Fig. rear hitch and trailer hitch

a.Remove the rear hitch and the trailer hitch
b.Extract PTO shaft stay(21) rearwards and take out shifter(22).
c.Be alert to the steel ball which may spring out of the shifter.Extract PTO shaft(9) rearwards and remove the change gears and related parts.
d.Remove gear,spur 12(1).

3-2. INSPECTION

Before and after disassembly,inspect each part for the items mentioned below.Parts which deviate from the specified values should be replaced.

-Wash clean all disassembled parts and check them for wear,damage,deformation,Burning ,etc. Defective parts should be corrected or replaced.

-As the drive pinion and the ring gear make a pair,they should be replaced together even if only one is found to be defective.

-Backlash between the drive pinion and the ring gear

Backlash	0.1-0.2 mm (0.004-0.008 in)

-Backlash between the diff-pinion and the dif-side gear.

Backlash	0.1-0.2 mm (0.004-0.008 in)

-When the backlash exceeds 0.5mm,also inspect the thrust collar for wear,defective collars should be replaced.

-Disengaging the resistance of PTO shifters.

Standard Value	18-22Kgf (40-49lbs)
Usable limit	17 Kgf (38 lbs)

* Measured at the shifter

3-3. REASSEMBLY

Reassemble the parts in reverse order of disassembly, following these instructions.

(1) Ring gear,Drive pinion,and related parts.

a. Apply oil to the drive pinion and related parts ahead of time.Then install them and tighten the assembly to the specified torque.

Tightening torque	1.4Kgf.m (9.36 ft.lbs)

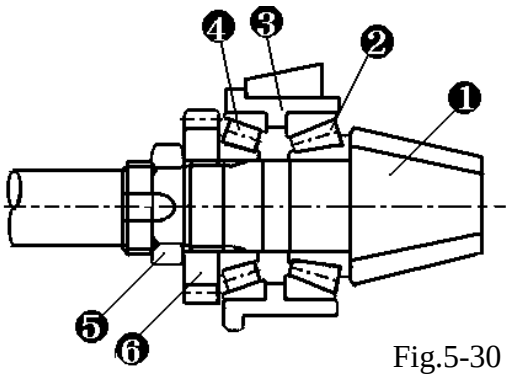


Fig.5-30

(1) Drive pinion
(2) Tapered roller bearing
(3) Drive pinion metal
(4) Tapered roller bearing
(5) Nut (M30X1.0)
(6) Gear

b.Be sure that the starting torque of the drive pinion meets the specified level.

Starting torque	8-11 Kgf.m (0.08-0.11KN.cm)

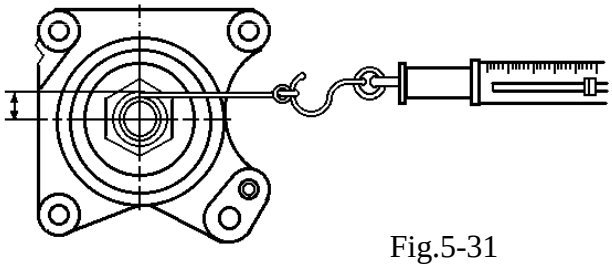


Fig.5-31

c.After the starting torque has been adjusted to the specified level,crimp the lock of the nut at one point as illustrated.

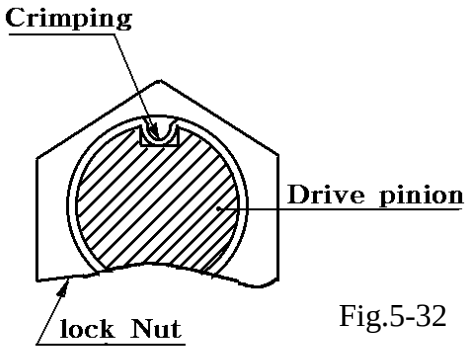


Fig.5-32

d. Tighten the drive pinion metal(support) by providing it with the same shimming thickness that it had when it was disassembled.

When the drive pinion or the ring gear has been replaced, the proper number of shims to be installed should be determined based upon the following procedure:

Drive pinion metal tightening torque	5.5-7 Kgf.m (39.8-69 ft.lbs)

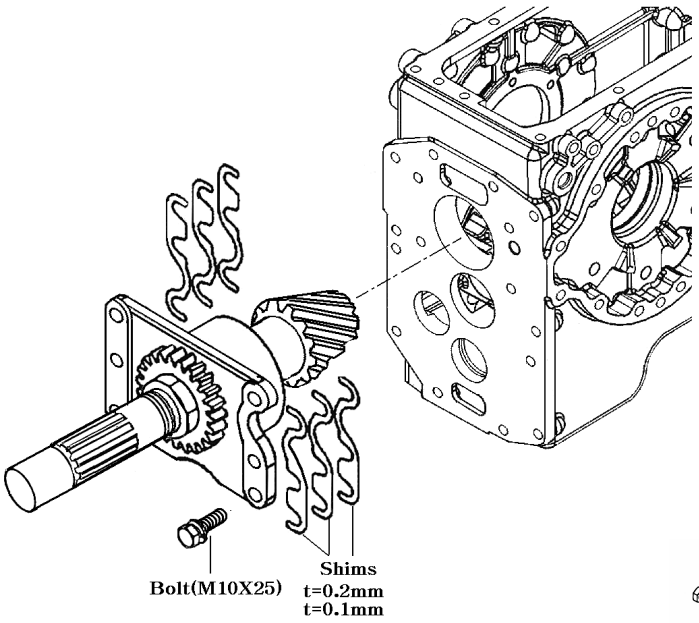


Fig.5-33

Note:

When assembling without replacing the pinion gear and ring gear with new ones,provide the same shimming thickness as that provided before disassembly.

e. Install the differential gears.

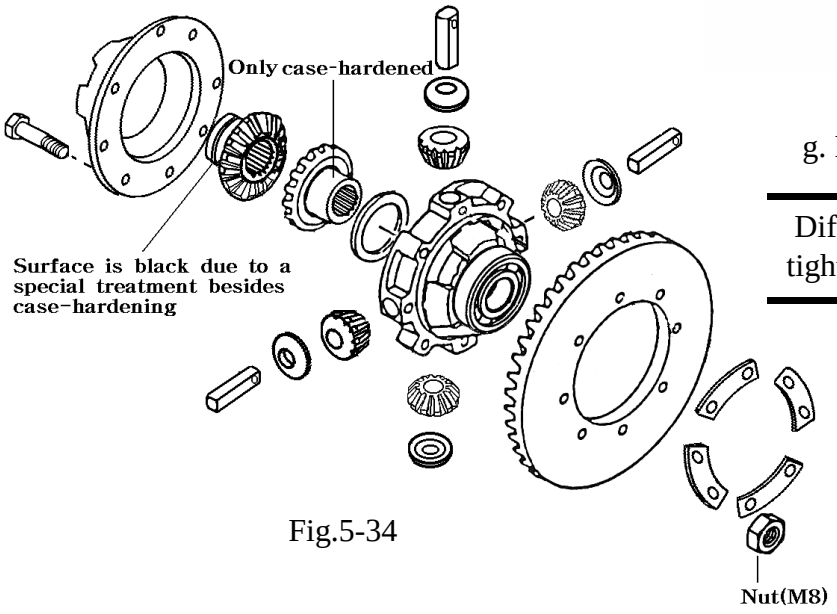


Fig.5-34

Ring gear tightening torque	9.0-11 Kgf.m (39.8-69 ft.lbs)

Note:

- As shown in Fig5-34,there are two kinds of differential side gears.Although are case hardened,the one installed on the side of the diff-lock is treated further and colored black. Take care not to mix them when assembling.
- Apply multi-purpose,quality grease to the parts mentioned below:

• Tooth surfaces of dif-pinions and dif-side gears
• Friction surfaces of dif-pinion shafts and dif-pinions.

f.Backlash between dif-pinion and dif-side gear should be within as range of 0.1 to 0.2mm(0.004-0.008 in) and these parts should turn smoothly.

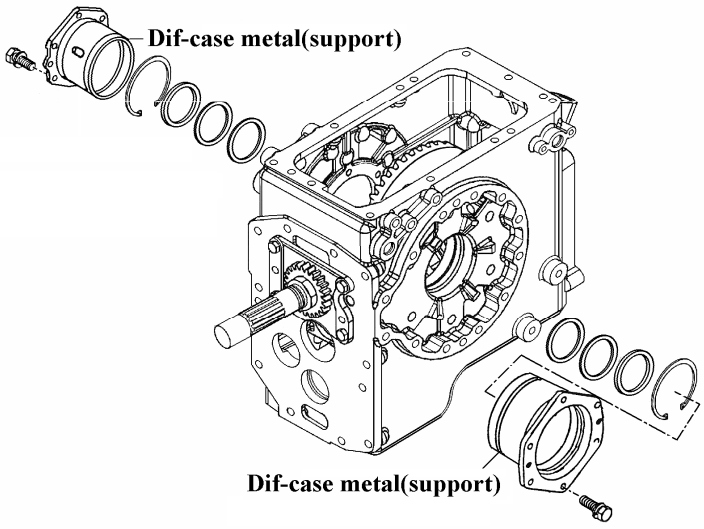


Fig.5-35

g. Install the differential gear assembly.

Diff-case metal tightening torque.	5.5-7 Kgf.m (39.8-69 ft.lbs)

Note:

When reassembling the used pinion and ring gear,reinstall the same thickness of shims as was installed before disassembly in each shimming position.

h.Backlash adjustment between the drive pinion and the ring pair(Fig5-35)

i.As the drive pinion and the ring gear make a pair,be sure not to mate them with other parts from differential tractors.

ii Adjust the shimming to backlash of 0.1-0.2 mm (0.004-0.008 in). The standard shimming is 0.4mm (0.016 in) on both sides.

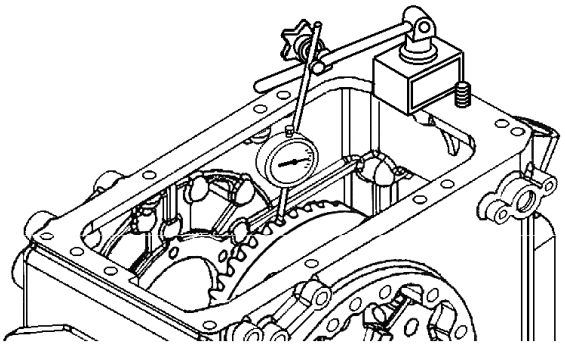


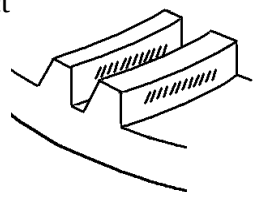
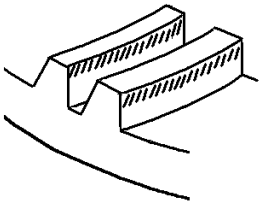
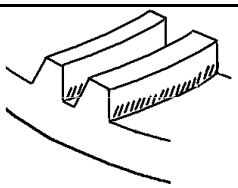
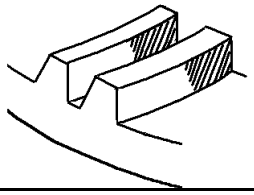
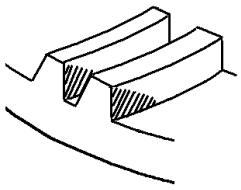
Fig.5-36

Note:

Strike the circumference of the ring gear both sides with a copper hammer by turning the ring gear manually,and check to see that the backlash remains unchanged.The backlash should be checked at four points 90 degrees apart to each other.

iii.inspection of the tooth bearing

Apply an even coat of oil-dissolved minimum on the drive pinion teeth and turn the drive pinion on the ring gear to check the tooth bearing by observing the bearing traces on the ring gear.

Correct Contact 	When drive pinion and ring gear are meshed correctly with each other and their backlash is within specified range,contact is in middle of ring gear tooth and is approximately 75% of total tooth width.
Tip contact 	Excessive backlash.Move differential case and shims from right side to left side.See”Assembly and installation”.
Root contact 	Inadequate backlash.Move differential case shims from left side to right side.See”Assembly and installation”.
Toe contact 	Too little engagement.Remove some drive pinion support shims.See Transmission:REAR TRANSMISSION ASSEMBLY-Setting cone center.
Heel contact 	Too much engagement.Add some drive pinion support shims.See TRANSMISSION:”REAR TRANSMISSION ASSEMBLY-Setting cone center.”

INSTALLATION OF A NEW PAIR OR RING GEAR AND DRIVE PINION

1.use a new pair of ring gear and drive pinion delivered from the manufacturer.Never mix its components with those of other pairs.

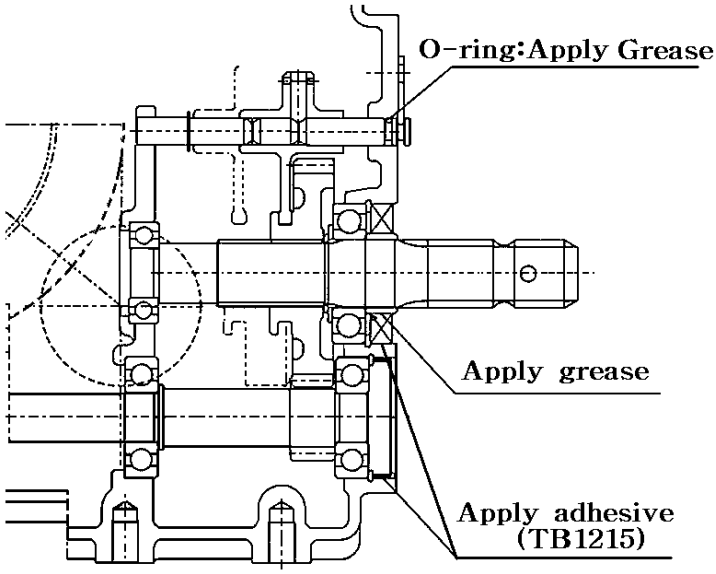
Note:

Every ring gear-dive pinion pairs is adjusted and inspected for tooth contact individually at factory.

2.Adjust the backlash between the ring gear and drive pinion to be 0.1-0.2mm(0.004-0.008 in) by shimming the drive pinion metal and right and left dif-case metal and make sure that their tooth contact is proper

(2) PTO shaft and related parts.

a.Pushing the PTO counter gear end into the bearing until the stop on the gear is securely seated against the bearing.The seal should be coated with an adhesive (THREE BOND TB1215) on the circumference before installing.
b.Install the oil seal on the PTO shaft,paying attention to its installed direction.
c.After installation,the slide coupling should smoothly slide and mesh with the designated gears.



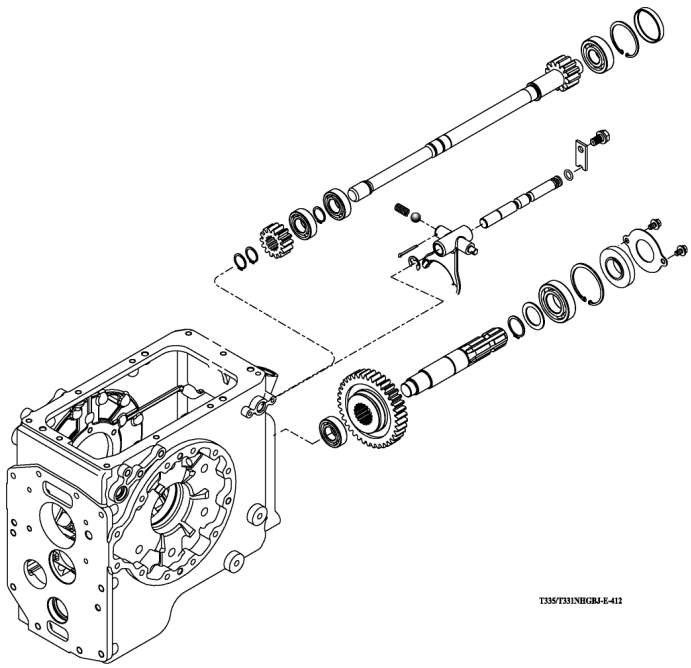
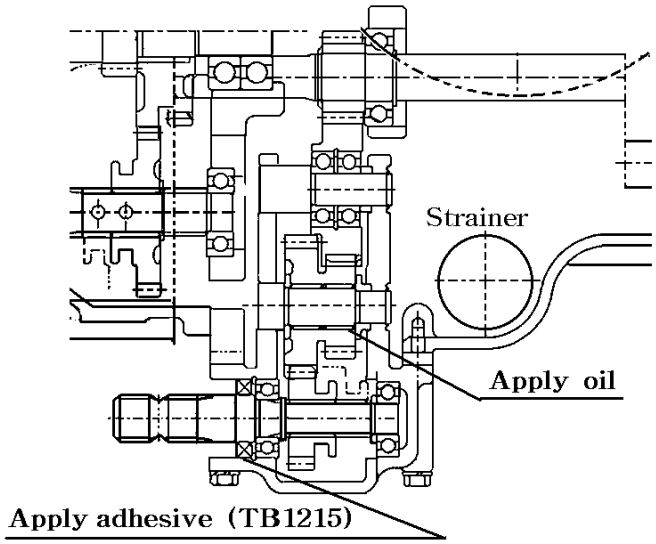


Fig.5-37

(3) MID PTO shaft and related parts.



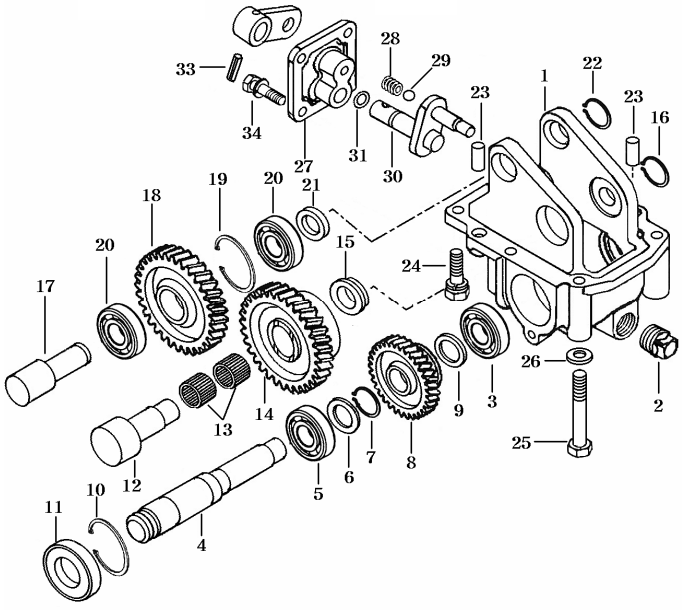


Fig.5-38

4. SHIFTERS AND RELATED PARTS.

4.1. CONSTRUCTION

(1) Forward and reverse control linkage mechanism.

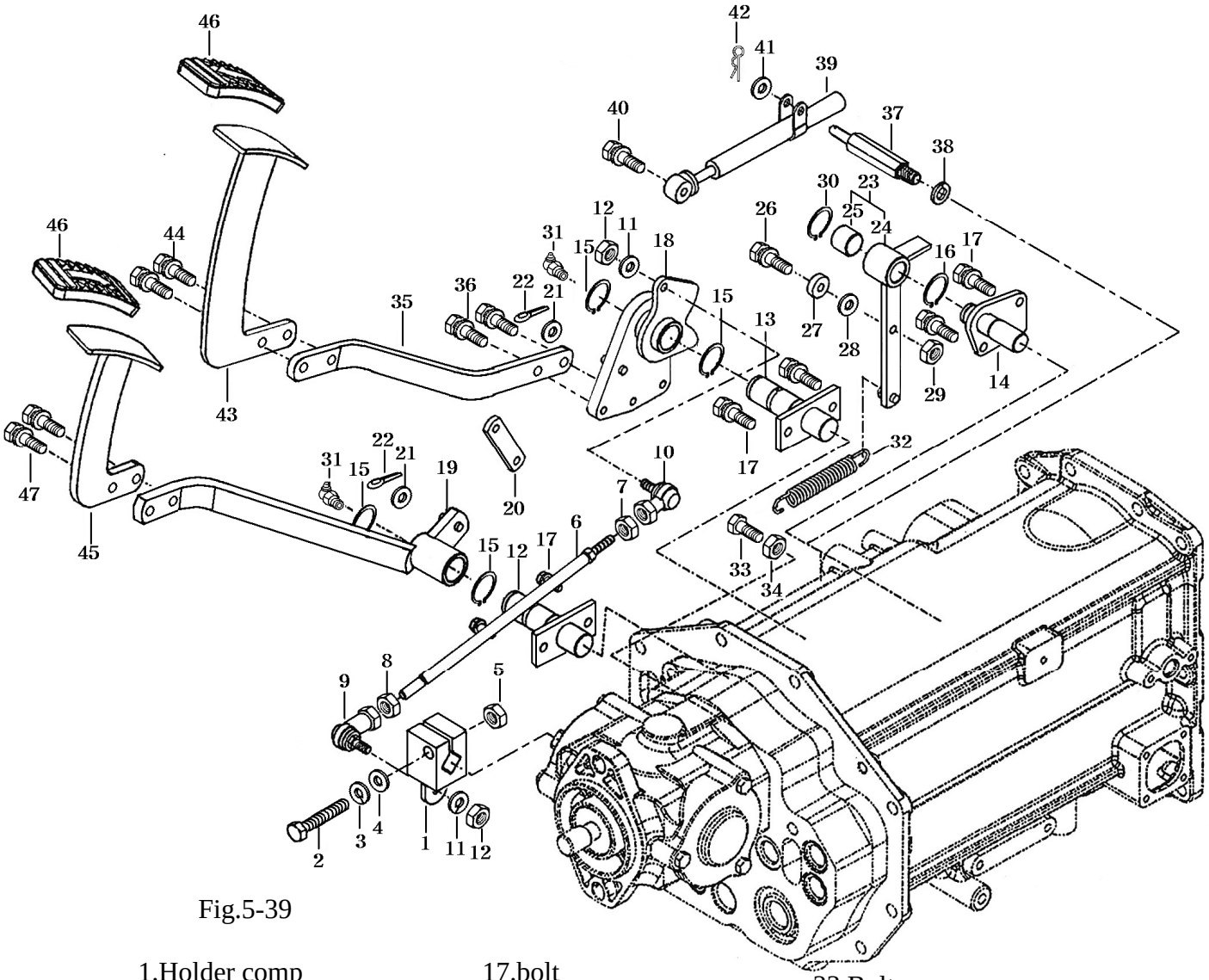


Fig.5-39

1.Holder comp
2.Bolt
3.Washer spring
4.Washer plain
5.Nut
6.Rod comp
7.Nut
8.Nut
9.Elbow,LH
10.Elbow,RH
11.Washer spring
12.Nut
13.Pin
14.Pin
15.Snap ring
16.Snap ring
17.bolt
18.Arm comp
19.Arm comp
20.Plate reverse
21.Washer plain
22.pin,split
23.Arm,cam
24.Arm,cam
25.Bush(20X23X20)
26.Bolt
27.Bearing ball
28.Washer plain
29.Nut
30.Snap ring
31.Nipple
32.Spring return
33.Bolt
34.Nut
35.plate,forward
36.Bolt
37.pin,oil damper
38.Washer spring
39.Damper oil
40.Bolt
41.Washer plain
42.Pin,snap
43.pedal comp(forward)
44.Bolt
45.Pedal comp(Reverse)
46.Pad
47.Bolt

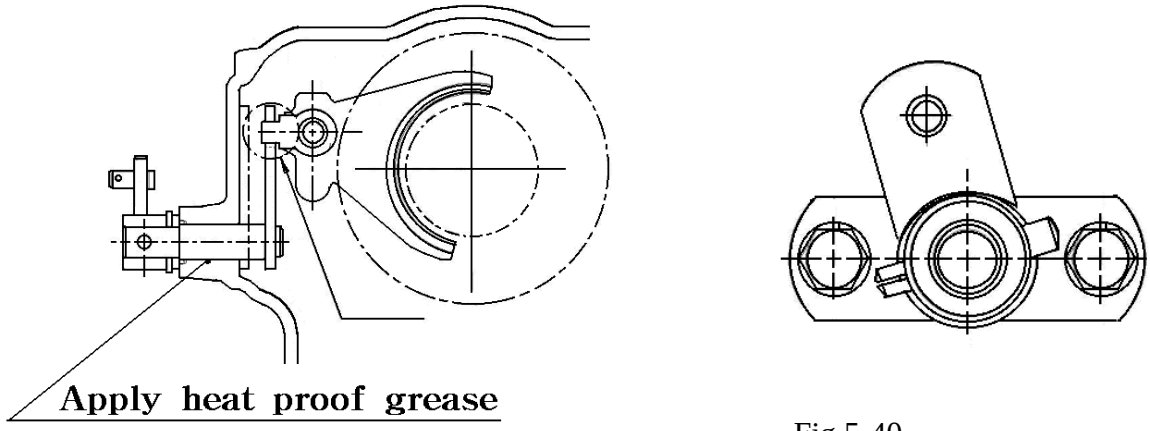
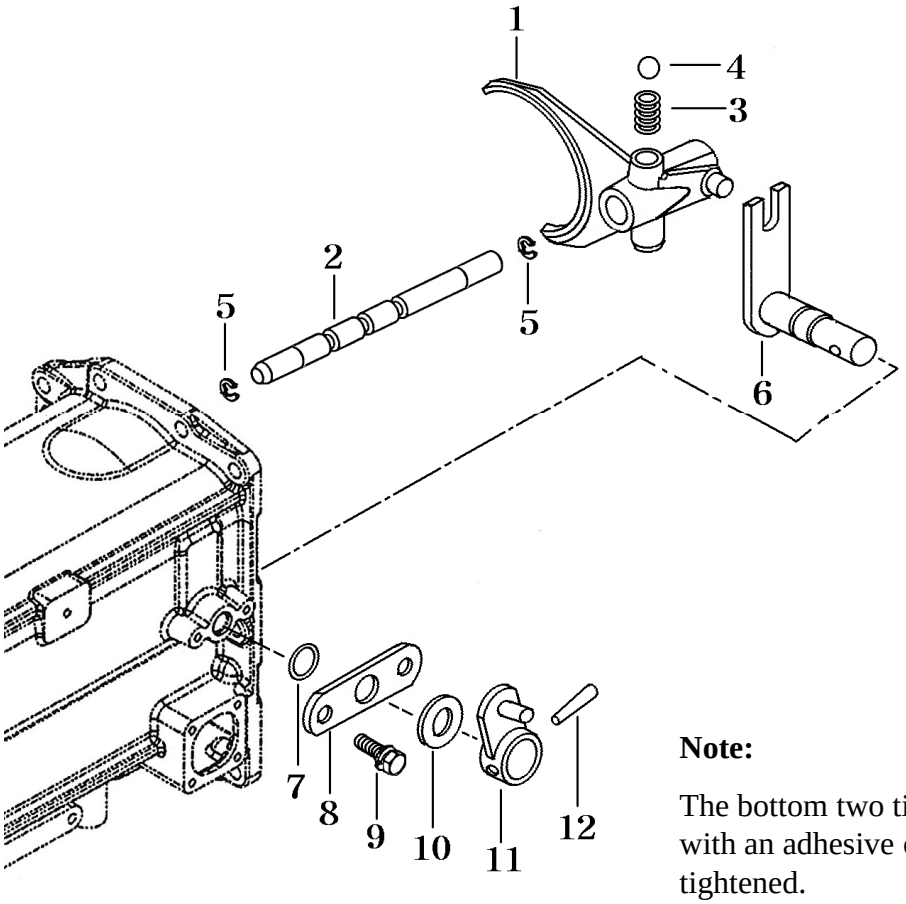


Fig.5-40

(2) range shifter (Speed range shift)



1. Fork,range
2. Stay,range shift
3. Spring,shifter
4. Ball,steel
5. E-ring
6. Hook,range
7. O-ring (P)
8. Plate
9. Bolt(M8X16)
10. Washer plane
11. Arm,sub range
12. Pin,Taper split

Note:

The bottom two tightening bolts should be coated with an adhesive on their threads before being tightened.

Fig.5-41

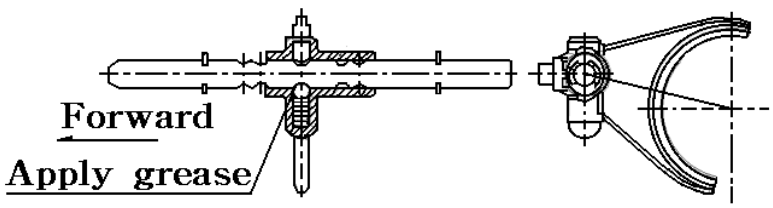
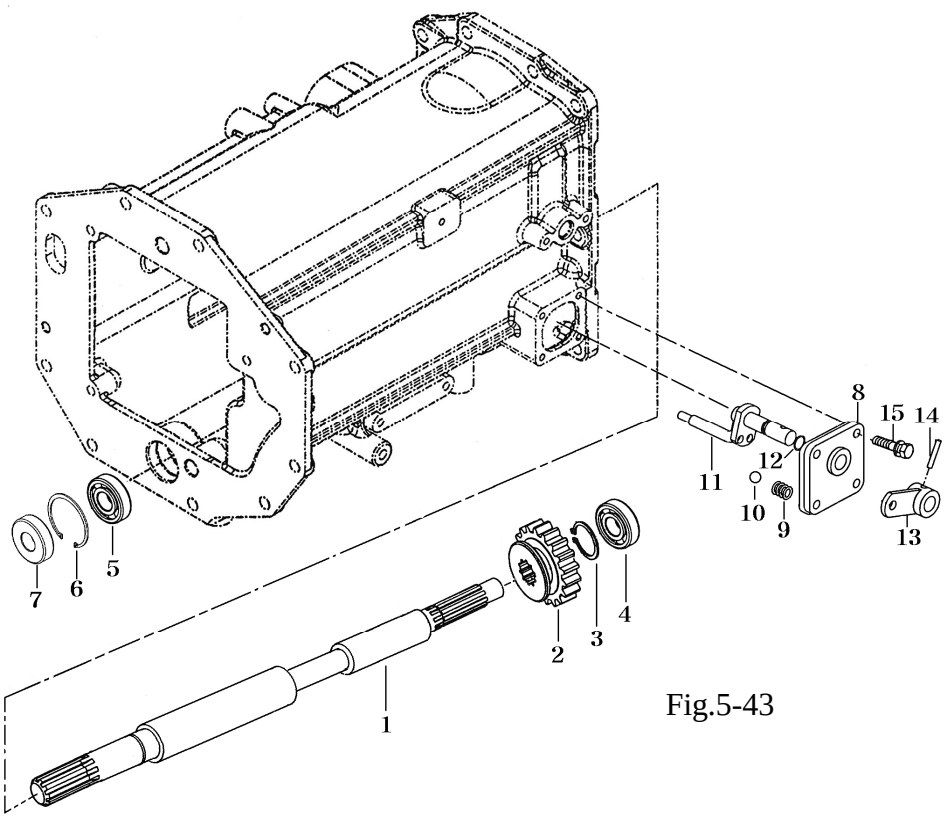


Fig.5-42

(3) Front drive change (4 WD shaft) mechanism



1.Shaft,4WD drive
2.Gear,spur 28T
3.C-ring(shaft)
4.Bearing,ball(6204)
5.Bearing,ball(6004)
6.C-ring(hole)
7.Oil seal
8.Boss
9.Spring, shifter
10.Ball steel
11.Arm comp
12.O-ring(P)
13.Arm comp,shift
14.pin
15.Bolt(M8X20)

Fig.5-43

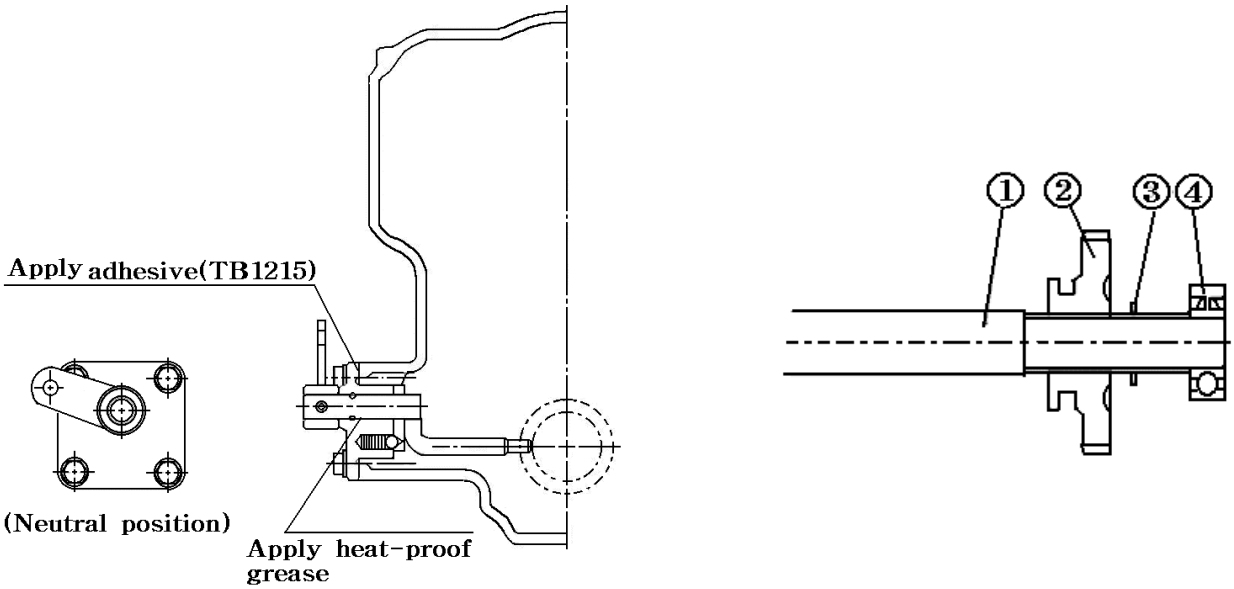


Fig.5-44

(4) Rear PTO mechanism

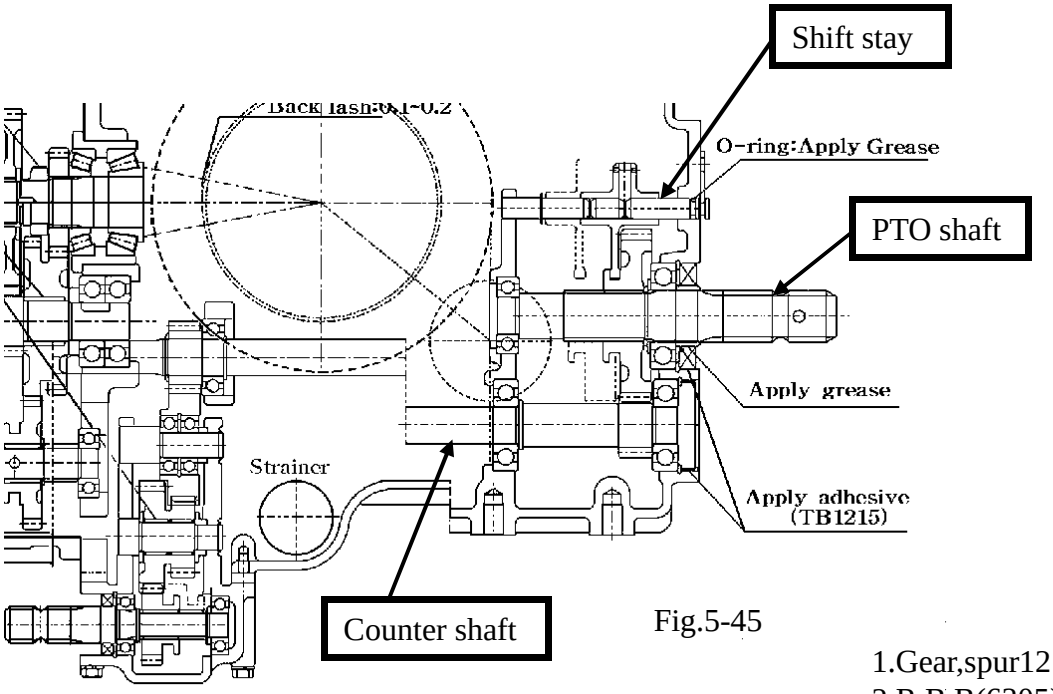
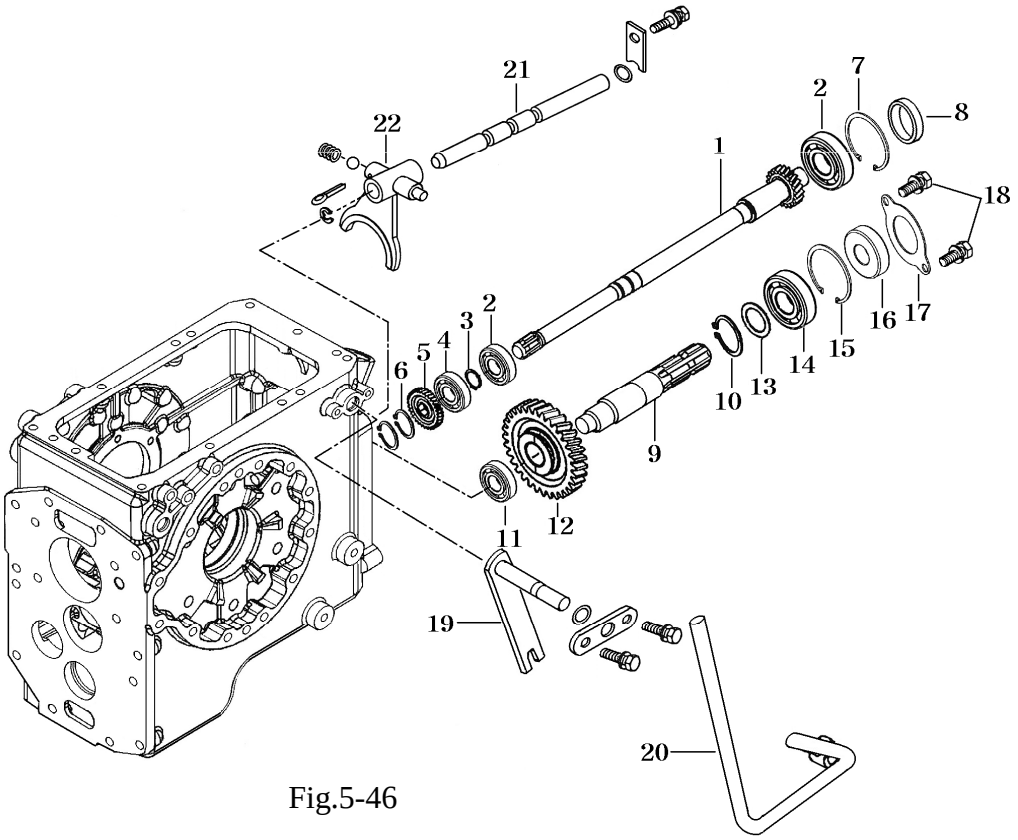


Fig.5-45



1.Gear,spur12
2.R.B.B(6305)
3.C-ring,shaft
4.R.B.B(6205)
5.Gear spur,14
6.C-ring,shaft
7.C-ring,hole
8.Seal 62
9.Shaft,PTO
10.C-ring,shaft
11.R.B.B(6205)
12.Gear,spur 37
13.Collar(35X50X2)
14.R.B.B(6207)
15.C-ring(hole)
16.Oil seal
17.Cover
18.Bolt
19.Hook,rear PTO
20.Lever,rear PTO
21.Stay,PTO shift
22.Shifter,PTO Low speed

Fig.5-46

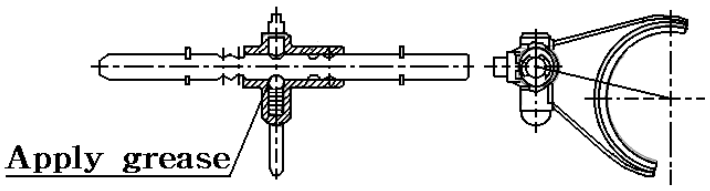
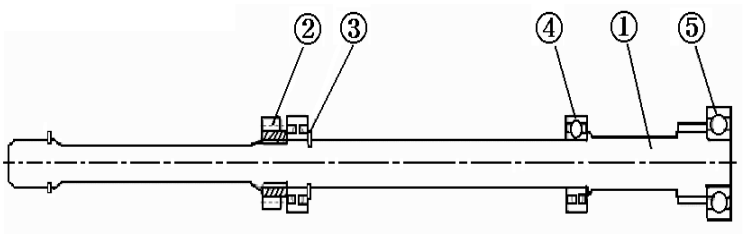


Fig.5-47

- REAR PTO counter shaft



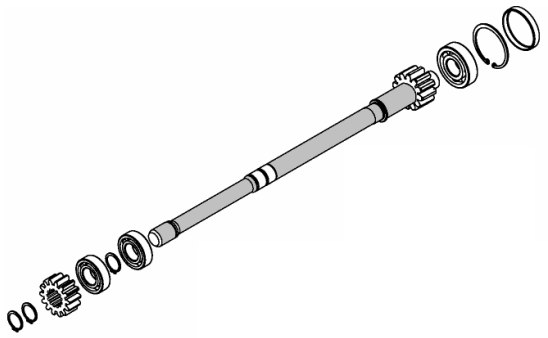
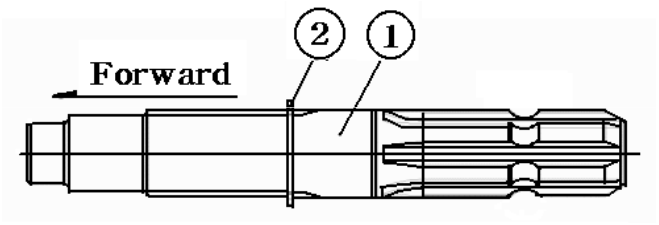


Fig.5-48

1.Gear,spur 12 2.Gear spur 14 3. Snap ring(shaft) 4. Ball bearing(6205) 5. Ball bearing(6305)

Note:
- When pushing the R.B.B's(6305,6205) into the gear ,spur 12,be careful only to push their inner races.
- The snap ring C should be securely seated in the groove and the press-processed side turned towards the outer side.
- Be sure not to mix different pairs of the gear(spur/14).
- Every time a gear is installed,its smooth rotation should be checked.

- REAR PTO shaft



1.Shaft PTO

2.Snap ring

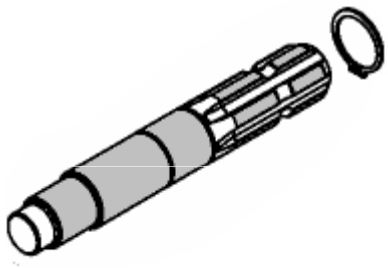
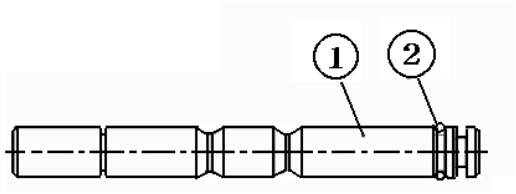


Fig.5-49

Note:
The snap ring C should be securely seated in the groove and the press-processed side turned towards the outer side.

- REAR PTO shift stay



1.Stay PTO shift

2.O- ring

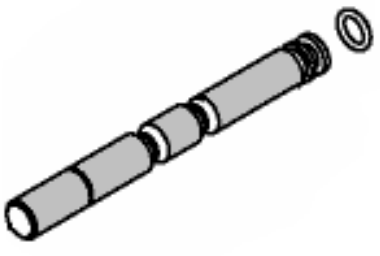


Fig.5-50

Note:
- When installing the O-ring to rear transmission case,take care not to damage it or allow to fall.

(5) MID PTO

(5-1) MID PTO CASE ASSY

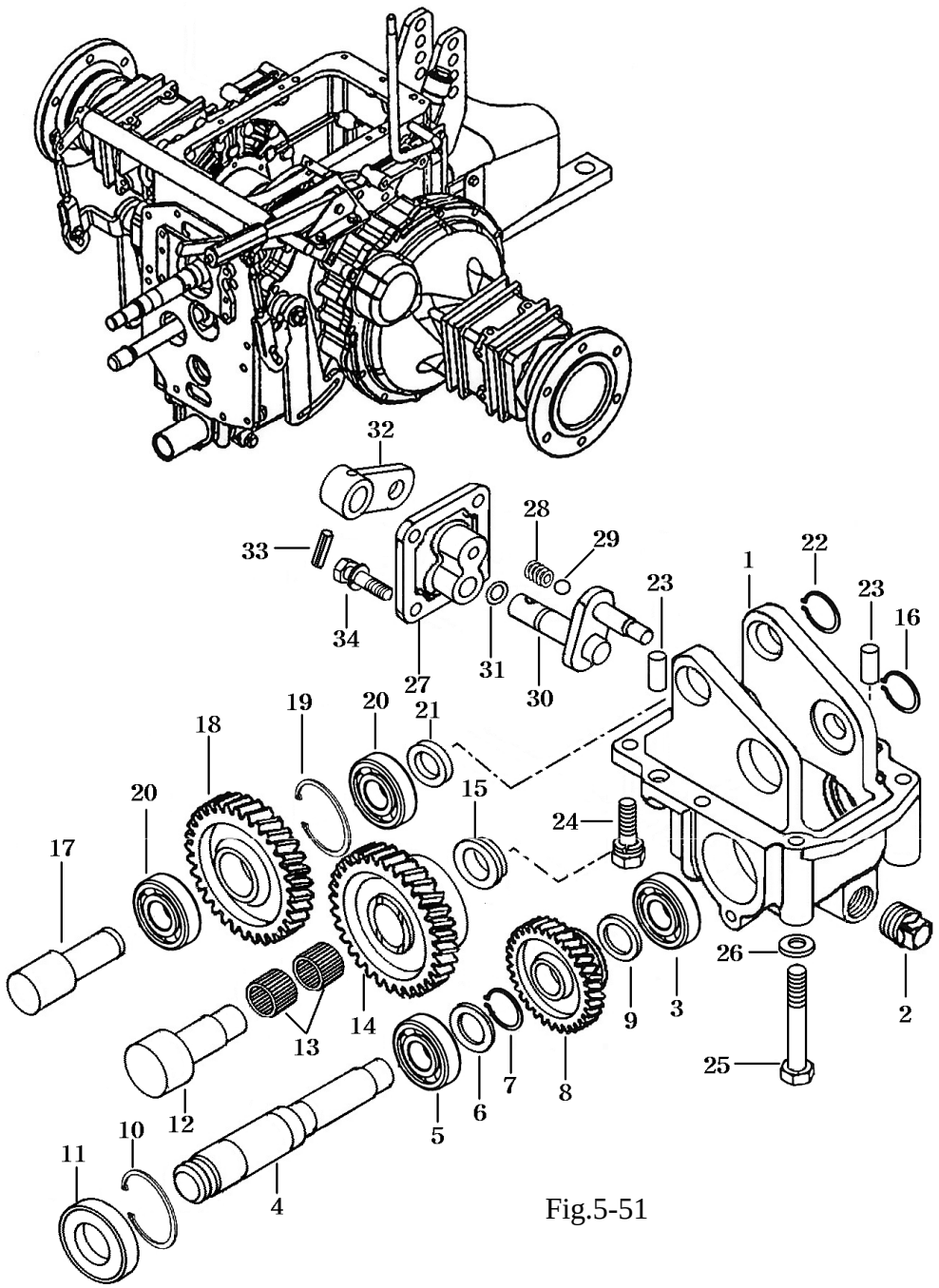
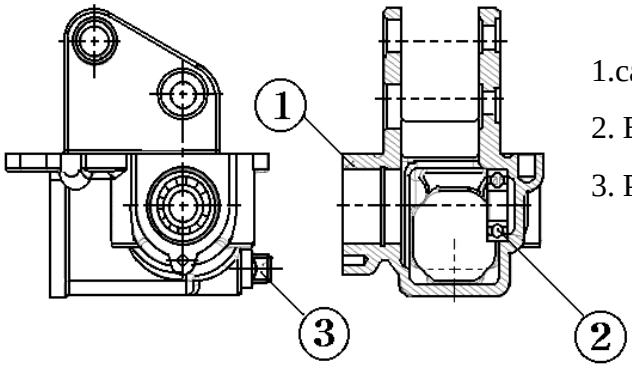


Fig.5-51

1. Case,Mid PTO
2. plug square.
3. Bearing ball(6203)
4. Shaft,MID PTO
5. Bearing ball(6004HL1)
6. Washer(20X30X1.8)
7. C-ring9shaft)
8. Gear,spur 16
9. Washer(17X25X3)
10. C-ring(hole)
11. Oil Seal
12. Counter Shaft 2,MID-PTO
13. needle roller bearing (KT202417)
14. gear,spur 23-16
15. Spacer
16. C-ring
17. Counter shaft 1
18. Gear,spur 25
19. C-ring
20. Bearing ball
21. Collar(17X24X6)
22. C-ring
23. Pin
24. Bolt
25. Bolt
26. Washer
27. Boss
28. Spring,shifter
29. Ball,steel
30. Arm comp
31. O-ring
32. Arm comp(shifter)
33. Pin
34. Bolt(M8X20)

(5-2) MID PTO CASE SUB ASSY



1.case MID PTO

2. Bearing,Ball(6203)

3. Plug

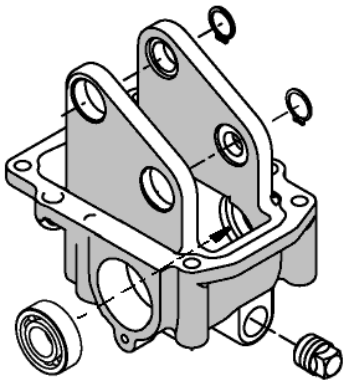
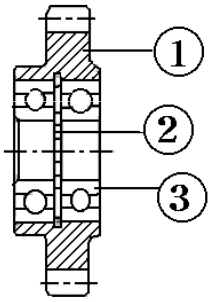


Fig.5-52

Note:
When pushing the R.B.B's(6203) into the CASE,be careful only to push their outer races.

(5-3) Gear (spur/25) sub assy.



1Gear,spur 25T

2.snap-ring(hole)

3.Bearing,Ball(6203)

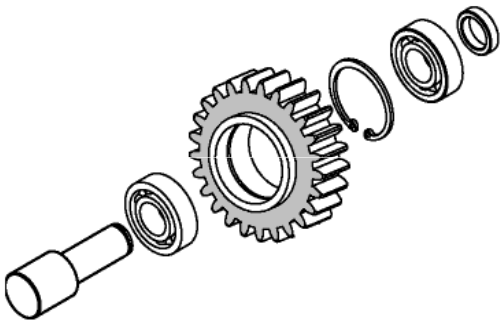


Fig.5-53

Note:
When pushing the R.B.B's(6203) into the gear,
be careful only to push their outer races.

(5-4) MID PTO shaft sub

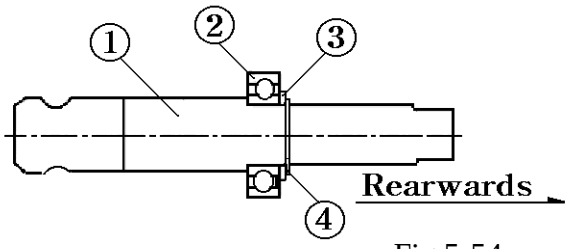
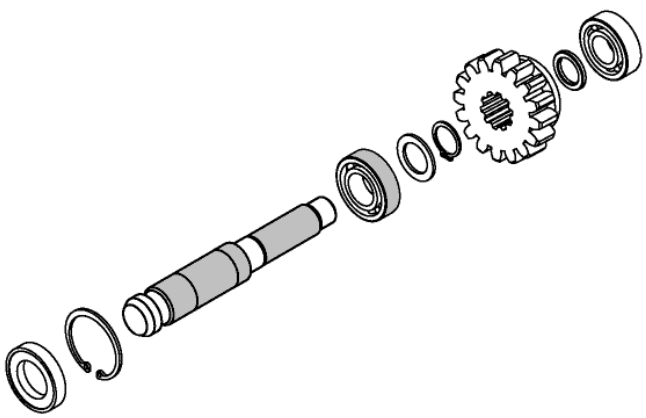


Fig.5-54

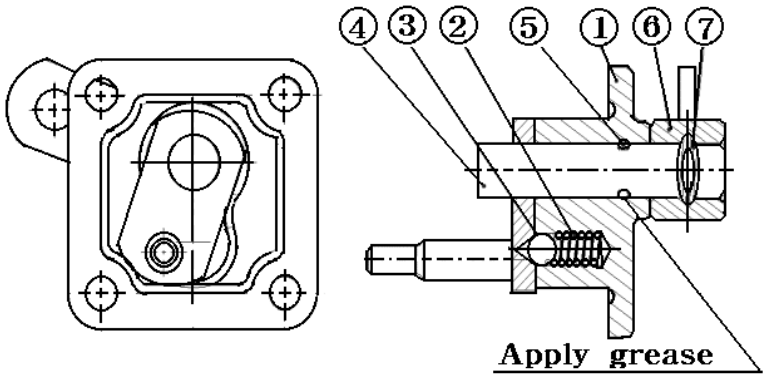


Note:

-When pushing the R.B.B's(6004) into the shaft,be careful only to push their outer races.

-The snap ring C should be securely seated in the groove and the press-processed side turned towards the rearward side.

(5-5) MID PTO shift metal SUB



1.Boss

2. Spring shift

3.Steel ball

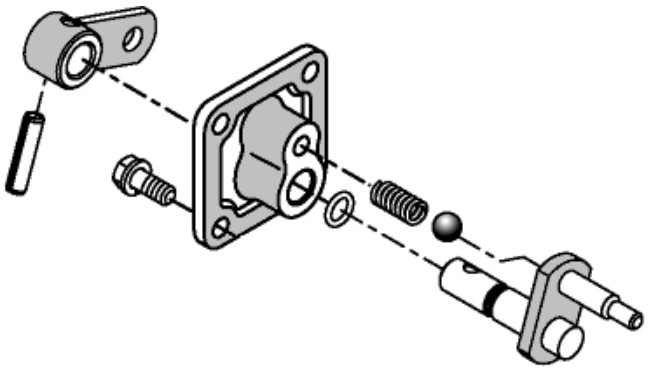
4.Arm comp

5.O-ring

6.Arm comp MID PTO shift

7.Spring pin

Fig.5-55



Note:

(1) When installing arm comp(6),take care not to mix the longer dimension .

(2) When installing the O-ring,take care not to damage it or allow it to fall.

(3) After installation,The Arm comp(shift) should slide with the designated grooves.

6) Drive pinion Sub assembly

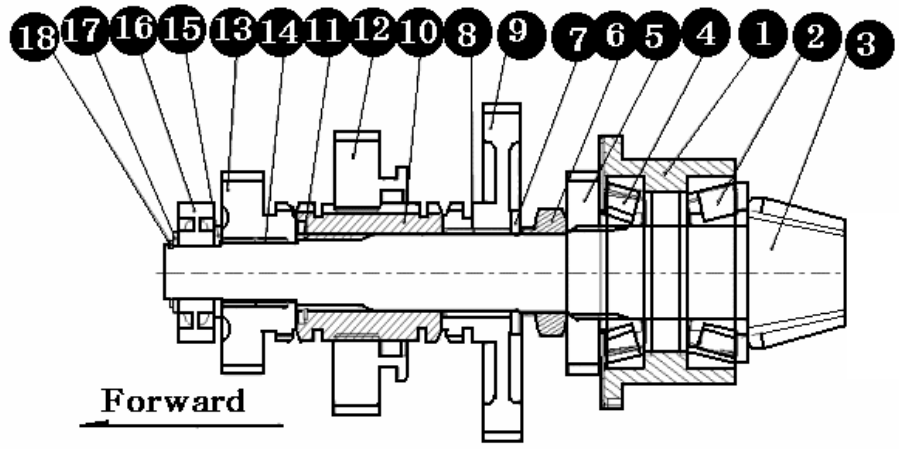


Fig.5-56

1..Metal pinion
2.Taper roller bearing
3.pinion drive 10
4.Taper roller bearing
5.Gear spur 23T
6.Nut(M30X1.5)
7.Washer(28X46X03)
8.Needle bearing
9.gear spur 40T
10.Hub(28X51X59)
11.Snap ring (shaft)
12.Gear spur 33T
13.gear helical 22T
14.needle bearing
15.Washer(20X34X03)
16.Ball bearing
17.Washer(20X30X1.8)
18.Snap ring (shaft)

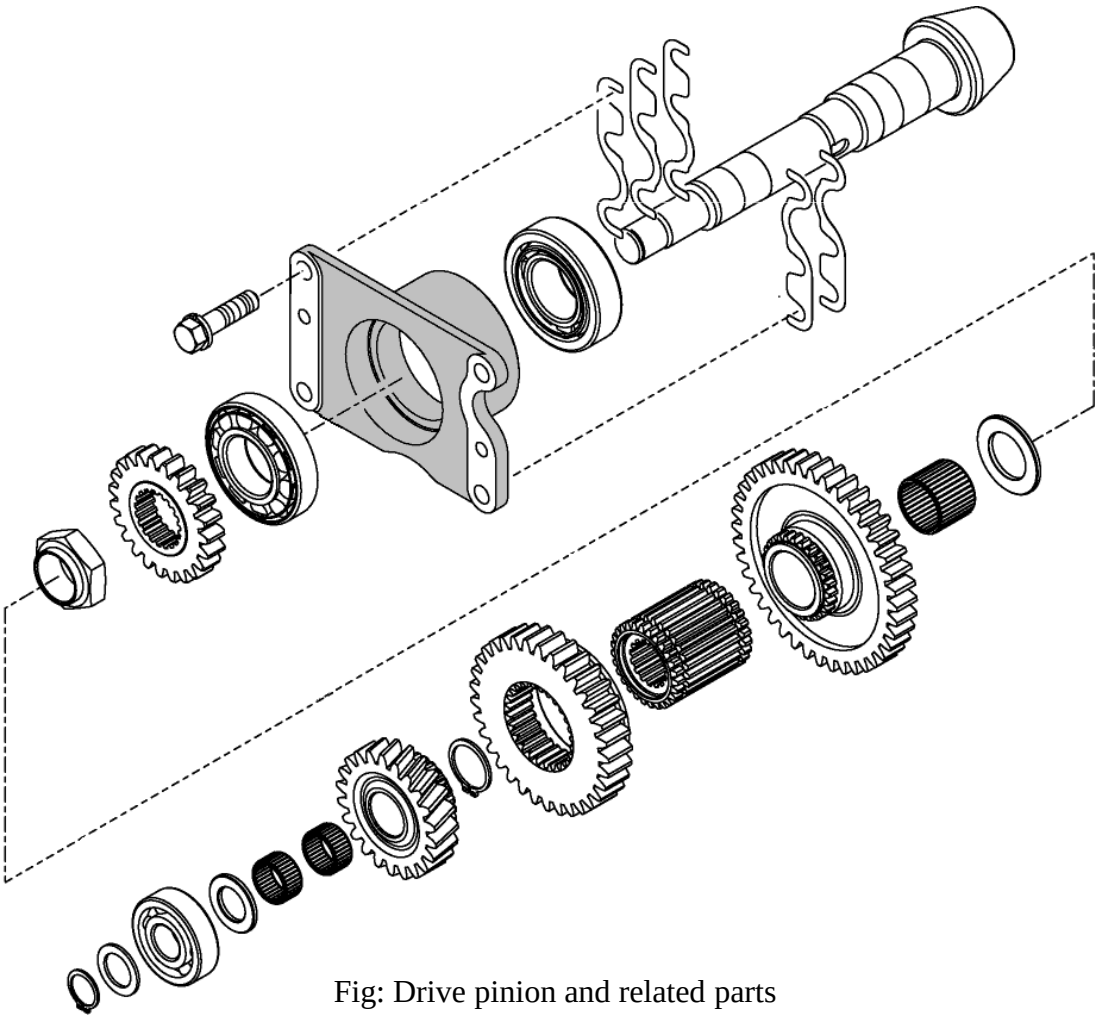


Fig: Drive pinion and related parts

Note:

a.Apply oil to the drive pinion and related parts ahead of time.Then install them and tighten the assembly to the specified torque.

b.Be sure that the starting torque of the drive pinion meets the specified level.
Starting torque is 8-11 Kgf.m (0.08-0.11KN.cm)

c.After the starting torque has been adjusted to the specified level,crimp the lock of the nut at one point as illustrated.

d. Be sure that these parts should turn smoothly

When the drive pinion or the ring gear has been replaced, the proper number of shims to be installed should be determined based upon the following procedure:

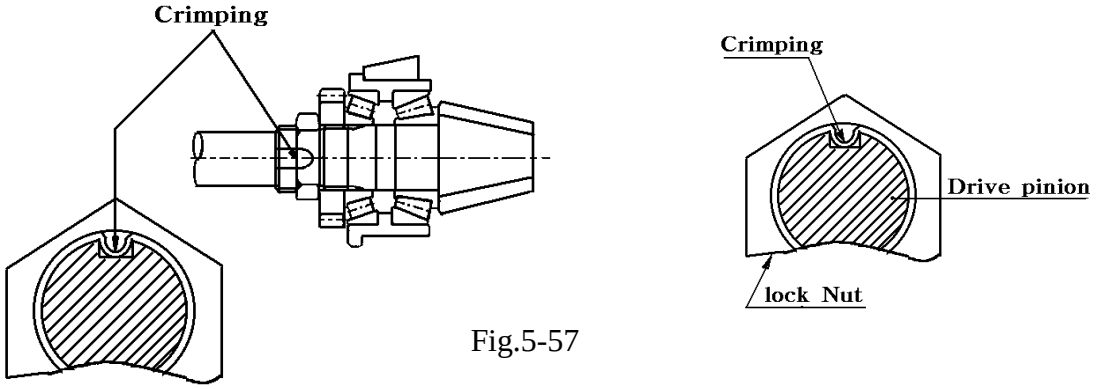
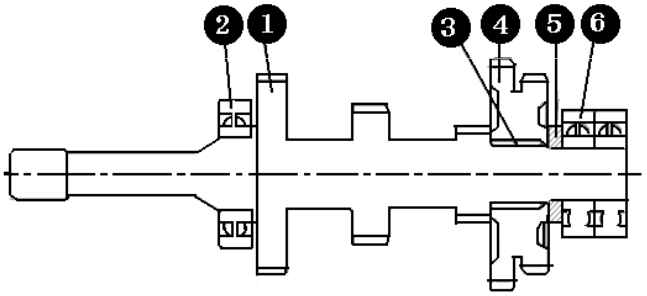


Fig.5-57

7) Sub change counter shaft



1.Gear range(13X20X29T)
2.Ball bearing(6207)
3.Needle bearing
4.Gear spur(30X35T)
5.Washer(25X46X07)
6. Ball bearing(6305)

Note:

1.Apply grease when installing Needle bearing
2.pay attention to the installed direction of gear(spur/30-35)
3.After installation,be sure to slide smoothly

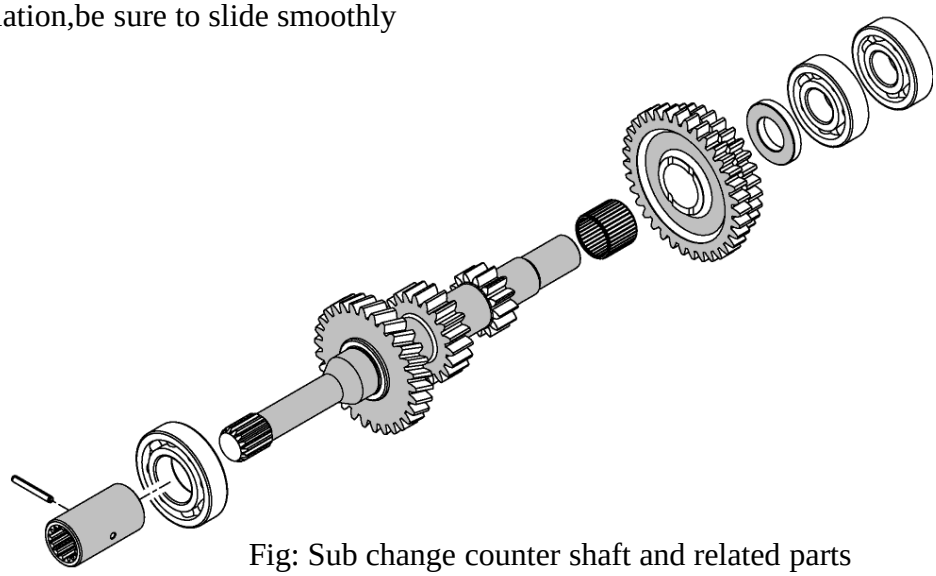


Fig: Sub change counter shaft and related parts

8.Differential gears.

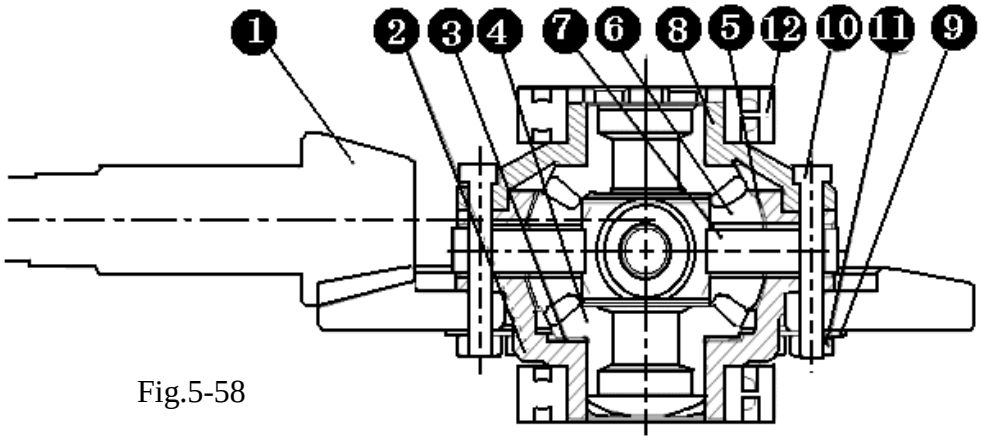
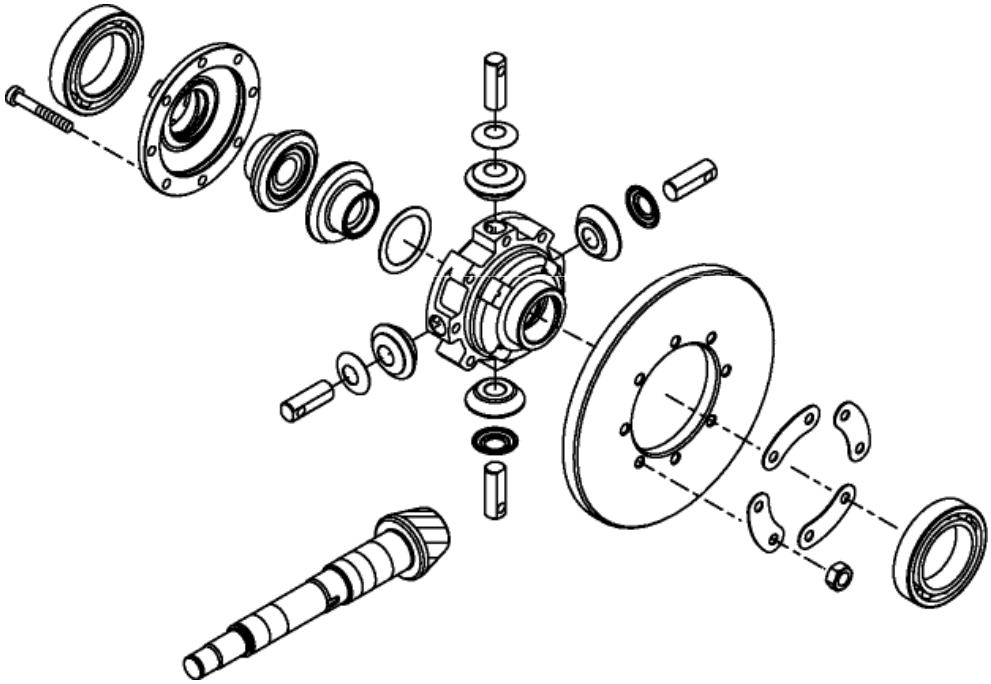


Fig.5-58

1.Bevel 10X51 2.Case Diff(L) 3.Gear bevel(20) 5.Thrust collar,pinion
6.pinion Diff(12) 7.Shaft diff pinion 8.Case Diff (R) 9.plate lock
10.Bolt,differential 11.Nut 12.Ball bearing(6011)



Differential gears and related parts

Note:

1.When assembling without replacing the pinion gear and ring gear with new ones,provide the same shimming thickness as that provided before disassembly.
2.Backlash between dif-pinion and dif-side gear should be within as range of 0.1 to 0.2mm (0.004-0.008 in) and these parts should turn smoothly.
3.When reassembling the used pinion and ring gear,reinstall the same thickness of shims as was installed before disassembly in each shimming position.
4.Backlash adjustment between the drive pinion and the ring pair(Fig5-8) i.As the drive pinion and the ring gear make a pair,be sure not to mate them with other parts from differential tractors.
5.Adjust the shimming to backlash of 0.1-0.2 mm (0.004-0.008 in). The standard shimming is 0.4mm (0.016 in) on both sides.

6. PRECAUTIONS FOR DISASSEMBLY, INSPECTION,AND ASSEMBLY

(1) Disassembly

When drawing a shifter stay from its shifter,be careful not to lose the steel ball.It can jump out of the shifter.

(2) Inspection

-Shifter –disengaging load:

Main change and sub change:18-22 Kgf (40-49lbs)

4WD change:25-29 kgf (55-64 lbs)

-Usable limit of shifter-disengaging load:

Main change & Sub-change:17 Kgf (38lbs)

4WD change: 24Kgf(53lbs)

-Wearing limit of each shifter: 0.5 mm (0.02 in)

(3) Reassembly

a.lubricate the grooves in the shifters.

b.Each shifter should be installed in the correct direction.

c. When installing the shifter on the shifter stay,Use the special tool as shown in Fig.5-59

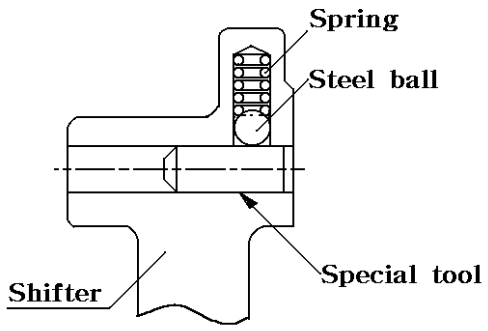


Fig.5-59

SECTION 4. TROUBLESHOOTING

1. WHEEL DRIVE SYSTEM

Problems	Causes	Countermeasures
Transmission makes noise in neutral	Insufficient or improper lubricant	Replenish or replace
	Excessive splines of change shaft,spline hub,etc	Replace
	Worn or broken bearings	Replace
	Slide couplings interfering with the gears due to worn or deformed shifters	Replace
Gears make a noise when shifted.	Improperly disengaged clutch	Repair or replace (Clutch pedal play)
	Wear in width of gears,splined hubs,collars,etc	Replace
	Defective Change shift fork	Replace
Gears disengage by themselves	Broken shifter springs	Replace
	Wear in width of gears,splined hubs,collars,etc	Replace
	Worn shifters	Replace
Gears do not engage or disengage	Improper disengaged shift lever	Repair or replace
	Gears are locked due to foreign matter between them	Remove the foreign matter

2. PTO DRIVE SYSTEM

problem	Causes	Counter measures
PTO does not spin with PTO shifted to ON	PTO shift lever is in neutral	Shift lever positively to ON
	Defective PTO switch	replace
	Clogged PTO valve	Wash clean
	Poor Pump	Replace
	Defective solenoid valve	Replace
PTO spins but does not produce sufficient torque.	Worn clutch disc	Replace
	Broken or fatigues seal ring at clutch sleeve	Replace
	Loose joint or broken O-ring of delivery valve	Retighten or replace
	Poor pump	Replace
	Clogged PTO valve	Wash clean
PTO does not stop when PTO switch is shifted to OFF	Defective PTO valve solenoid	Replace
	Poor PTO valve (contamination)	Wash clean
	Broken clutch piston return spring	Replace
	Poor switch	Replace
PTO follows too much when PTO switch is shifted to OFF	Improper oil	Replace
	Insufficient warming up	Let tractor warm up sufficiently
	Poor PTO clutch brake	Replace
	Weak or broken piston return spring	Replace
	Poor PTO valve(contamination)	Wash clean
	Deflected clutch plate	Replace

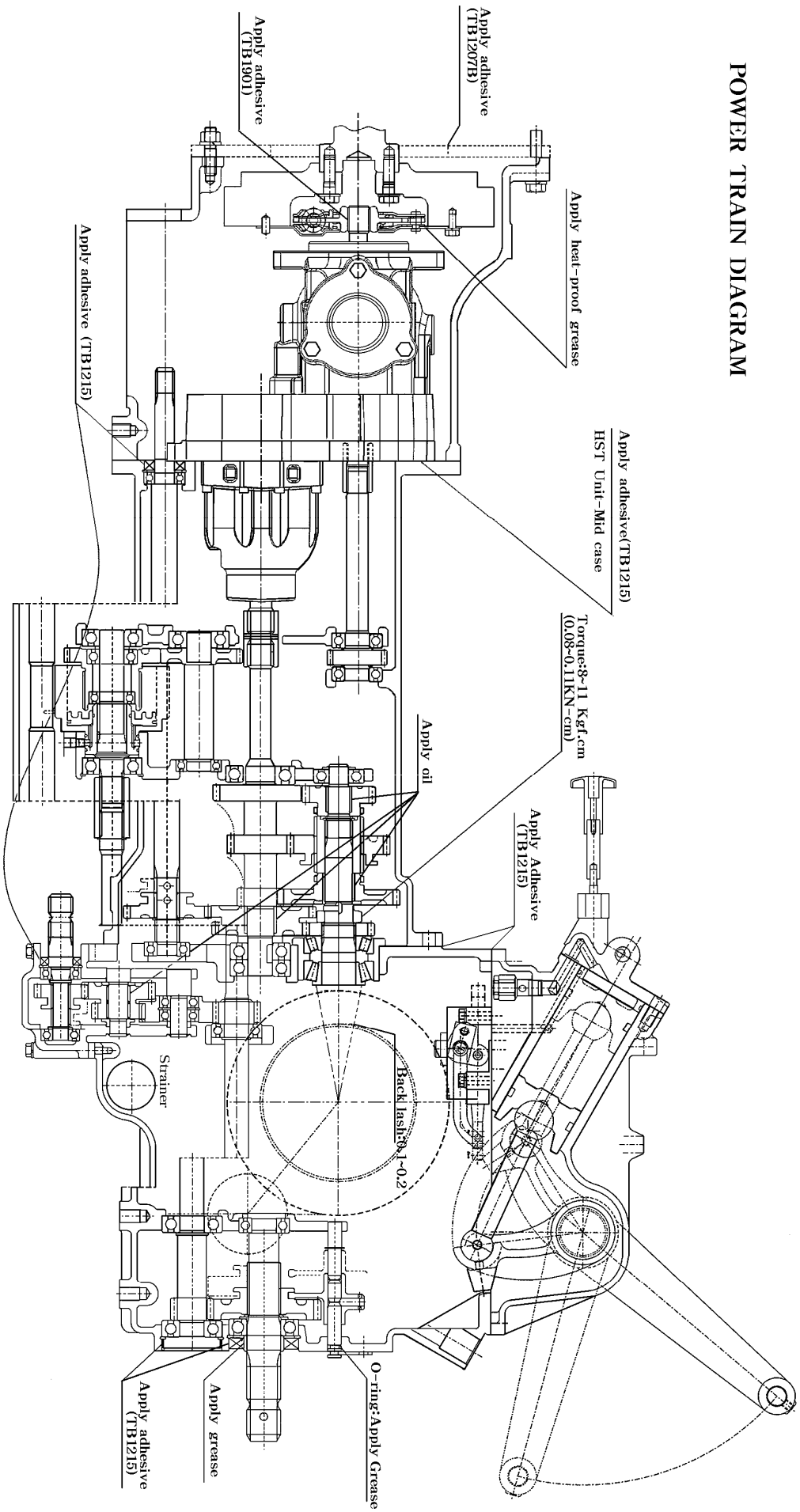

Apply adhesive (TB1207B)
Apply adhesive (TB1901)
Apply heat-proof grease
Apply adhesive (TB1215)
Apply adhesive(TB1215) HST Unit-Mid case
Torque:8~11 Kgf.cm (0.08~0.11KN-cm)
Apply oil
Apply Adhesive (TB1215)
Strainer
Back lash:0.1~0.2
Apply adhesive (TB1215)
Apply grease
O-ring:Apply Grease

Fig.5-60

CHAPTER 6
FRONT AXLE

CHAPTER 6. FRONT AXLE(4WD)---------- 6-1

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2-3. Reassembly ---------- 6-8

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3-2. Inspection ---------- 6-12
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Chapter 6 Front axle(4WD)

1. GENERAL DESCRIPTION

The 4WD front axle is a center pivot type.The front wheel drive mechanism is incorporated as a part of the axle.

The front wheel drive power is taken off the rear transmission and transmitted to the differential in the front axle where the power is divided into right and left and to the respective final cases.

In the final cases,the transmitted revolution is reduced by the bevel gears to drive the front wheel.

The 4WD mechanism with bevel gears provides wider steering angle and greater durability.

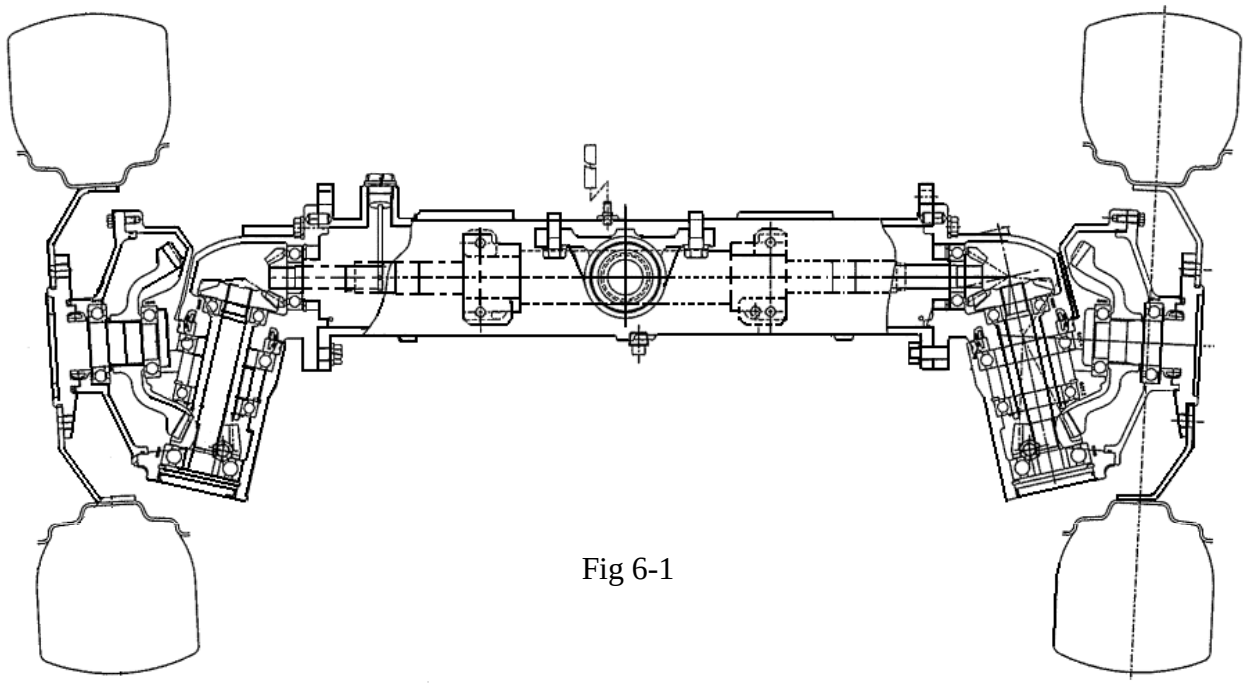
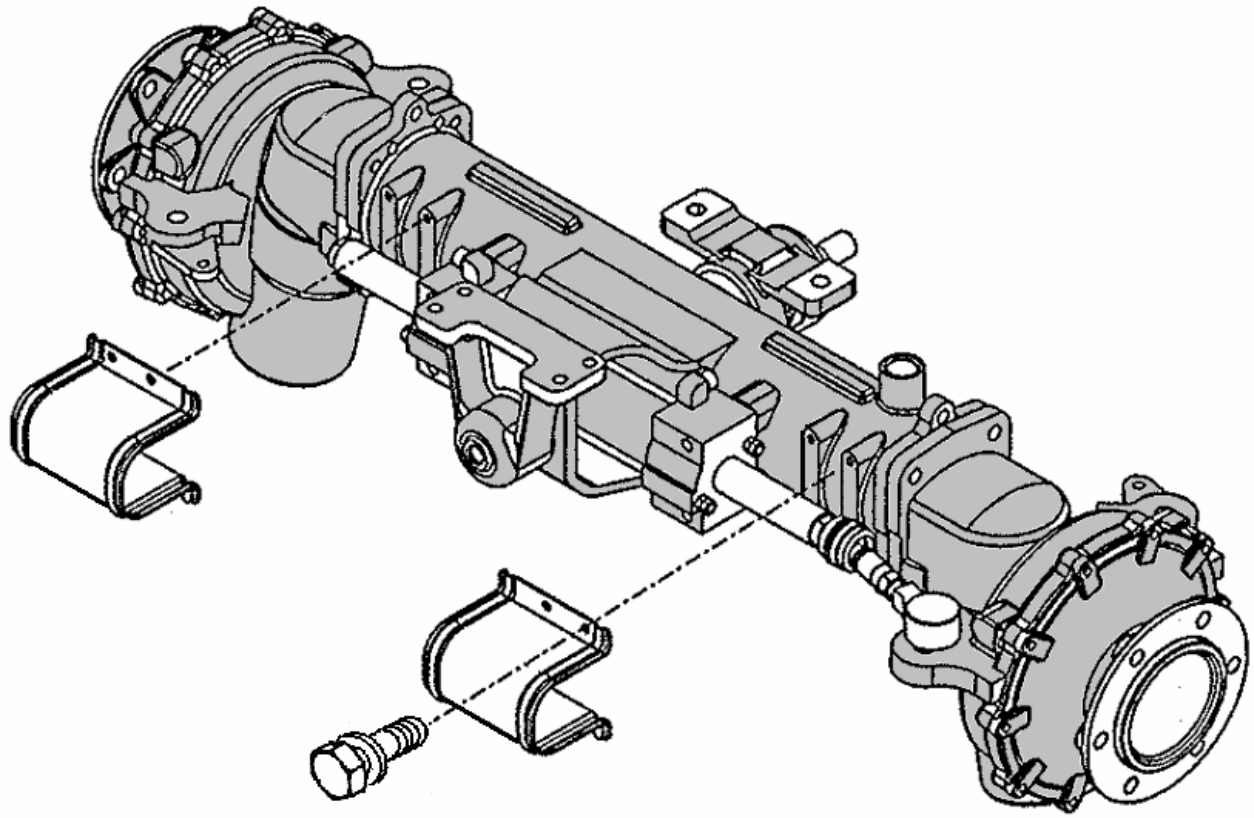


Fig 6-1



SECTION 2. SPECIFICATIONS

		T303HST/T353HST
Wheel alignment	Toe-in (mm)	2~6
	Camber	3° ± 1°
	Caster	3° ± 1°
Front axle	Pivot metal (F) bore (mm)	Φ55
	Pivot metal (R) bore (mm)	Φ80
	Pivot metal (F) bush (mm)	50X55X20
	Pivot metal (R) bush (mm)	75X80X30
	Housing (F) Diameter (mm)	Φ50
	Housing (R) Diameter (mm)	Φ75
	Front wheel steering angles	52°

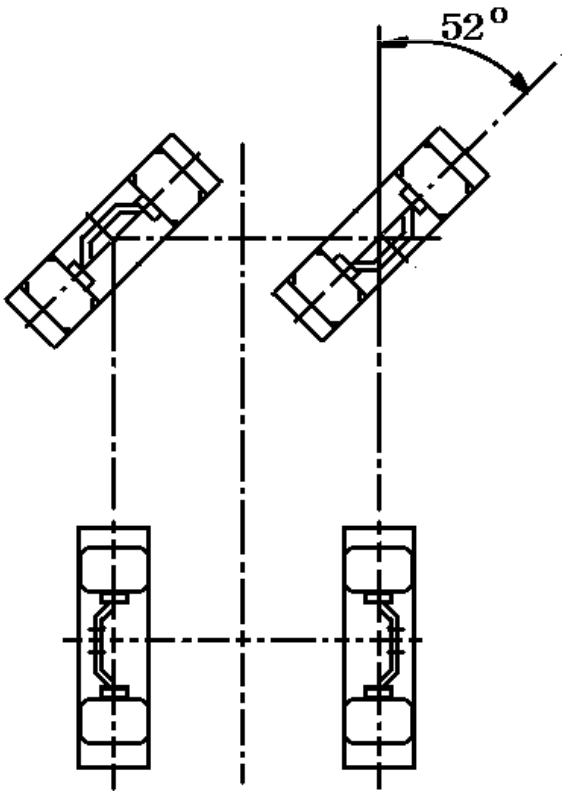


Fig.6-2

SECTION 3. DISASSEMBLY,INSPECTION,AND REASSEMBLY

1. CENTER PIVOT

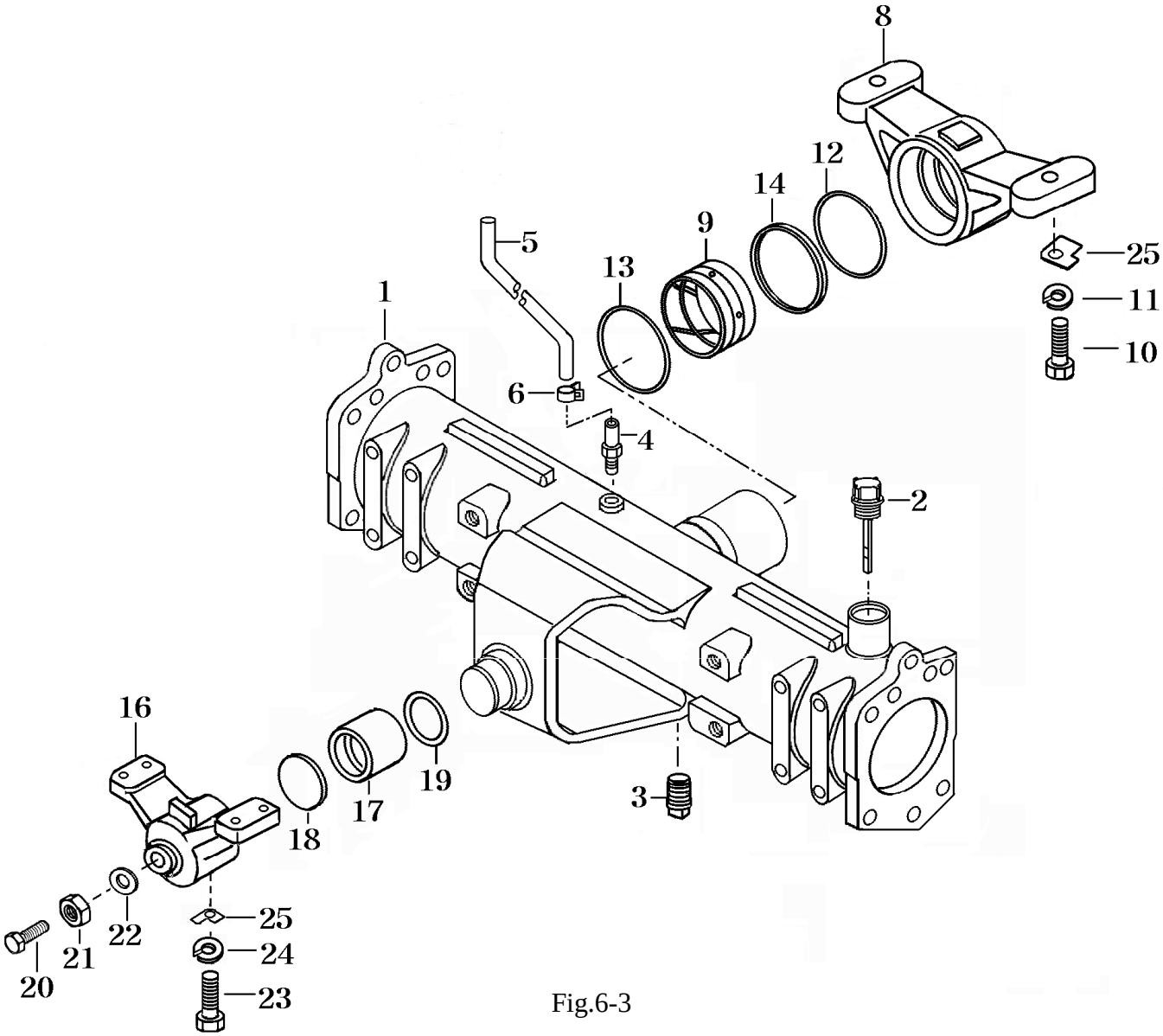


Fig.6-3

1.Housing,front axle
2.Oil cap
3.Plug
4.connector
5.Hose(820)
6.Clamp,(worm/14.5)
8.Metal,pivot(R)
9.Bush(75X80X30)
10.Bolt (M16X40)
11.Washer,spring(M16)
12.O-ring(P)
13.O-ring
14.Spacer (R)
16.Metal pivot(F)
17.Bush(50X55X20)
18.Spacer (F)
19.O-ring(G 55)
20.Bolt
21.Nut
22.Seal washer
23.Bolt(M12X40)
24.Washer spring
25.Washer

1.1.DISASSEMBLY

1) Dismount the front wheel drive shaft, referring to the pertinent paragraph in chapter 2.
2) Remove the right and left tie rods.
3) Suspend the front axle bracket with a chain.
4) Remove the front metal clamping bolts.The front axle can then be separated from the axle bracket.
5) Remove the front and rear pivot metals.

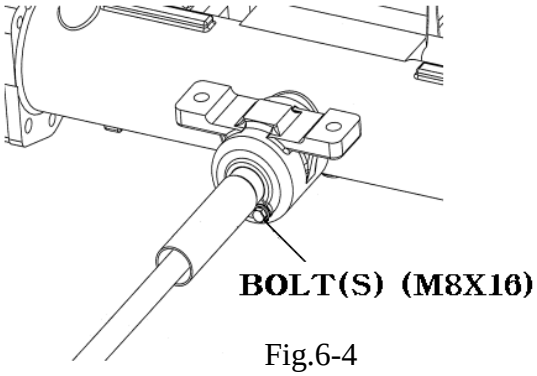


Fig.6-4

1.2.INSPECTION

1) FRONT AXLE SHAFT DIAMETER

Measure the diameter at a roll bush contact point with a micro-meter or vernier calipers.If the measured value is less than usable limit,replace the housing front axle or bush in Metal pivot (F)or Metal pivot (R) .

	Front	rear
Standard value as assembled	Ø50	Ø75
Usable limit	Ø49.9	Ø74.9

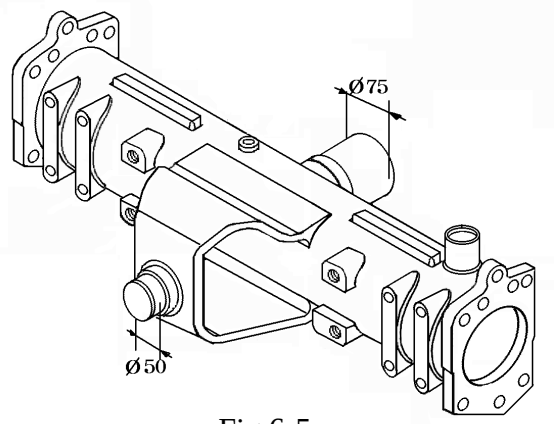


Fig.6-5

2) FRONT AXLE BUSH BORE DIAMETER

Measure the bore diameter of the roll bush in the pivot metal(F).If the measured value exceeds the usable limit,replace the bush.

	Front	rear
Standard value as assembled	Ø50	Ø75
Usable limit	Ø50.35	Ø75.35

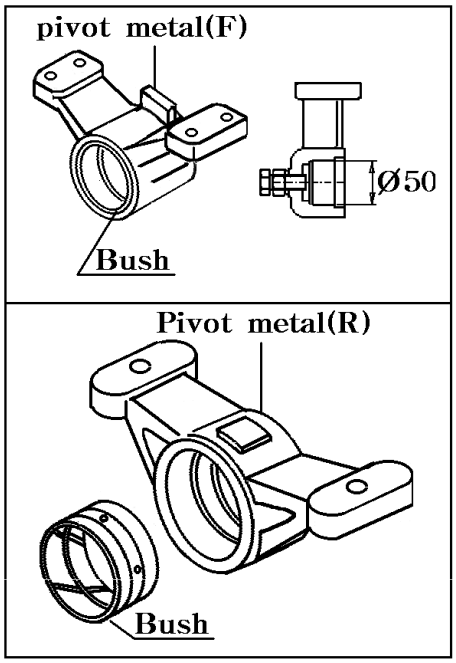


Fig.6-6

3) Worn or damaged oil seals,O-rings, bearings,etc.should be replaced.

1.3 REASSEMBLY

Reassemble the parts in reverse order of disassembly,following these instructions.

1) Lips of the oil seals,bush contact surfaces, and O-rings should be coated with grease in advance.
2) When installing the roll bushes,abide by the following precautions.

-Use an installer and press in the bush on a press.
-The bore surface should be coated with grease in advance.
-The shim of the roll bush should reach position as shown Fig.6-7.In other words the seam should be in a position which is free from any load.

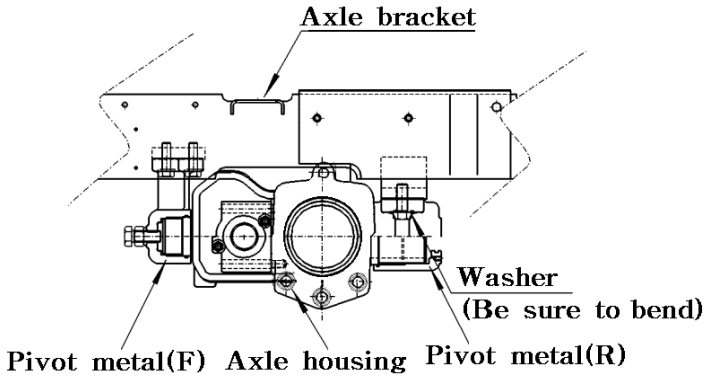


Fig.6-7

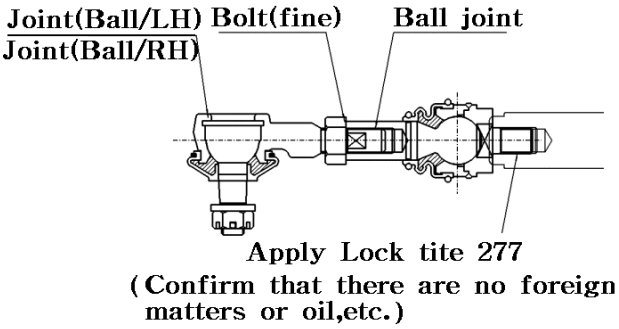


Fig.6-9

Note:
Slanted or forced installation of the bush should be avoided,and the bore surface of the bush should not damaged.

3) Pay particular attention to the installed direction of thrust collar,that is,with the sharply-edged face turned towards the bevel gear case.
4) When the thrust collar has been replaced or the fore-and aft play of the front axle exceeds the usable limit,correct play by screwing in the adjust bolt on the top of the pivot metal(F).

Note:
After correcting the pivot metal play,tighten the lock nut of the adjusting bolt to a torque of 11.7~13.7KN-cm(1200~1400 kgf-cm)

5) The reassembled front axle should rock smoothly while pivoting.
6) When the tie-rods are reinstalled,the toe-in should be adjusted.At the same time,the steering angles of the both wheels should also be adjusted.
7) Be sure the dimension C and D is same size and Adjust E and F as same dimension.

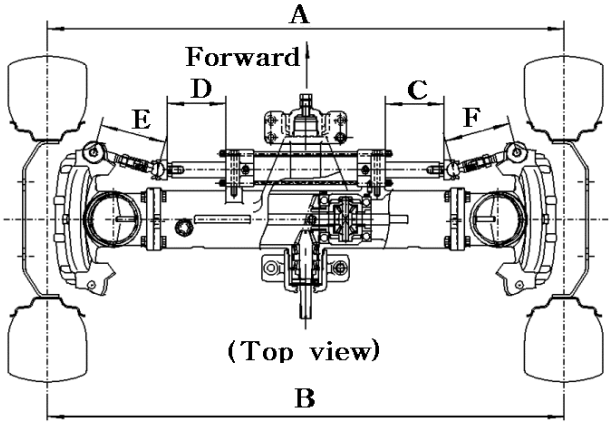


Fig.6-8

2. FRONT DIFFERENTIAL

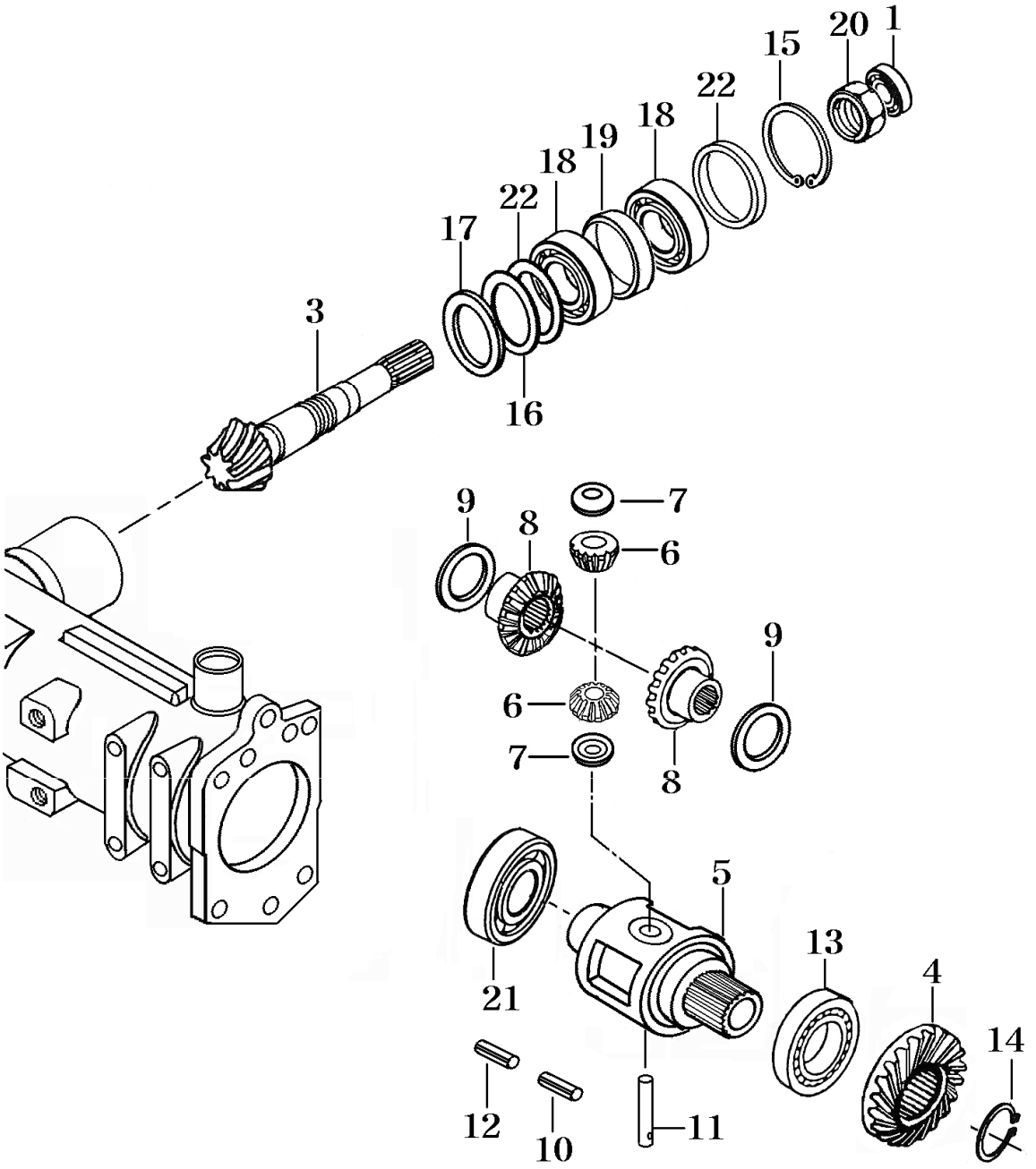


Fig.6-10

1.Oil seal 3.Pinion bevel 8T 4.Gear bevel 35T 5.Case front Diff 6.Pinion Diff (12)
7.Thrust collar 8.Gear diff side (20) 9.Washer thrust 10.Pin spring 11.Shaft diff pinion
12. Pin spring 13.Bearing Ball(6212) 14.Snap ring 15.Snap ring(hole) 16.Shim(A)
17.Shim(B) 18.Bearing taper roller 19.collar 20.Nut(M30) 21. Bearing ball(6211)
22.Shim

2.1 DISASSEMBLY

1) As concerns operation prior to removal of the front axle,refer to the paragraph covering disassembly of the center pivot
2) Remove both wheels
3) Remove the drain plug from the final case and drain oil from the final case.
4) remove both final case assembly (A and B) from the front axle(Fig.6-11)

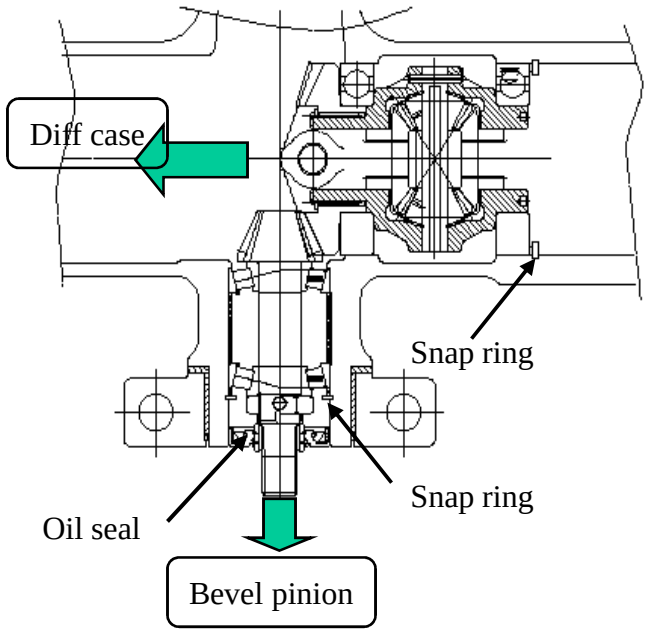


Fig.6-11

5) Remove the oil seal,assuring parallelism of the ring gear and bearing

Note:
The number of shims(1) installed and the the shimming thickness should be noted for later reference.

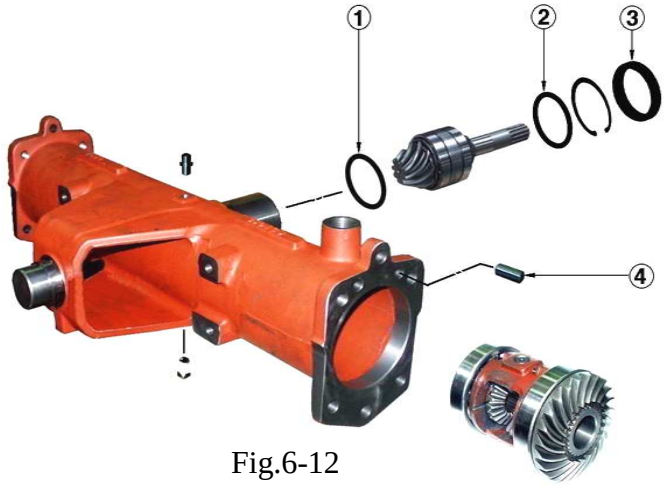


Fig.6-12

6) Remove the bearings from the Axle housing And the ring gear,and then the ring gear can be separated from the Axle housing.
7) Remove the straight pin(4) which retains the axle housing.

Note: Discard the removed straight pin and oil seal and install a new pin and Oil seal when reassembled,because this pin and oil seal is apt to be damaged when removed.
8) Remove the snap ring and the bevel pinion can then be removed together with the TRB's (Fig.6-11)
9) When separating the TRB's from the bevel pinion,release the calking of the lock nut and remove the bearings.

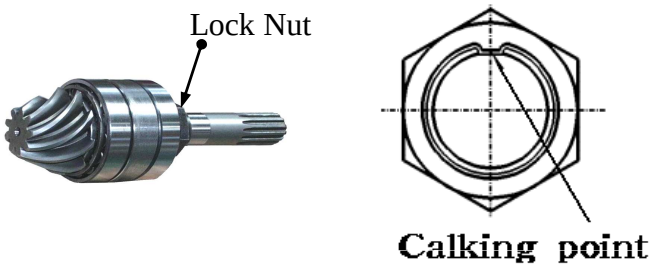


Fig.6-13

Note:
The lock nut should be calked at a point completely apart from the threads may damage the threads of the bevel pinion.

2.2 INSPECTION

1) visually check the bearing surfaces of the bevel pinion and ring gear teeth.

Note:
The bevel pinion and the ring gear should be replaced as a pair.

2) seriously worn or damaged parts should be replaced.

2-3.REASSEMBLY

Reassembly the parts in reverse order of disassembly,following these instructions.

1)Each friction surface should be coated with grease in advance.
2)The bevel pinion and the ring gear make a distinct pair after a mesh adjustment performed at the factory. Consequently, when reassembling the pair,be sure to pair parts with a same reference number.

-Tighten the lock nut to the specified starting torque of the single unit of the bevel pinion.

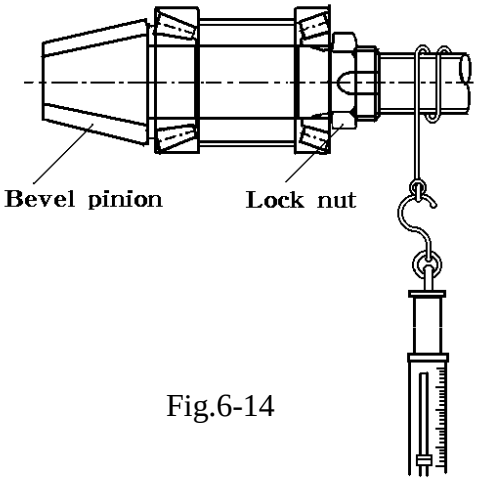


Fig.6-14

Note:
As a general rule,a disassembled lock nut should be replaced and a new one should be installed.However,when there is no alternative but to reuse the disassembled lock nut assure that it can lock securely.

Note:
Measure the starting torque a manner as shown in the figure 6-14.

Specified starting torque	6 -7 Kgf-cm (0.43-0.51 ft.lbs)

-When any of the bevel pinion,ring gear,TRB, collar,etc.has been replaced, inspect the bevel pinion assembly for thrust play in the front axle housing.

Specified thrust play mm(in)	0.1-0.3 (0.004-0.011 in)

Note:

TRB and collar should be replaced as a pair.

(1) Bevel pinion (8)

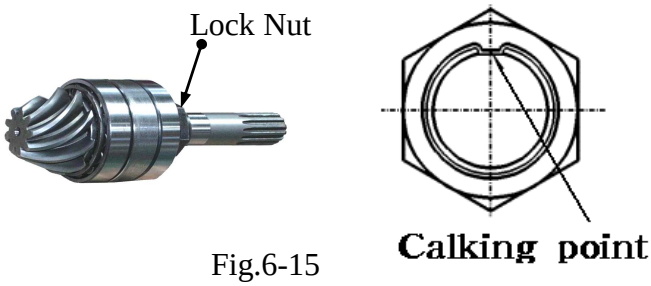


Fig.6-15

(2) FRONT DIFF CASE

a.When installing washer and thrust washer,apply fresh Molybdenum grease ahead of time.
b.Apply fresh Molybdenum grease to teeth of diff-pinion and dif-side gear.
c.Each parts should be washed clean,and There should be no sharp edge to the surface of thrust washer.
d.When assemble the spring pin,Be sure the spring pin should be different direction (Ø5 and Ø3)
e. When any of the bevel pinion,ring gear,TRB, collar,etc.has been replaced,inspect the bevel pinion assembly for thrust play in the front axle housing.

Specified thrust play mm(in)	0.1-0.3 (0.004-0.011 in)

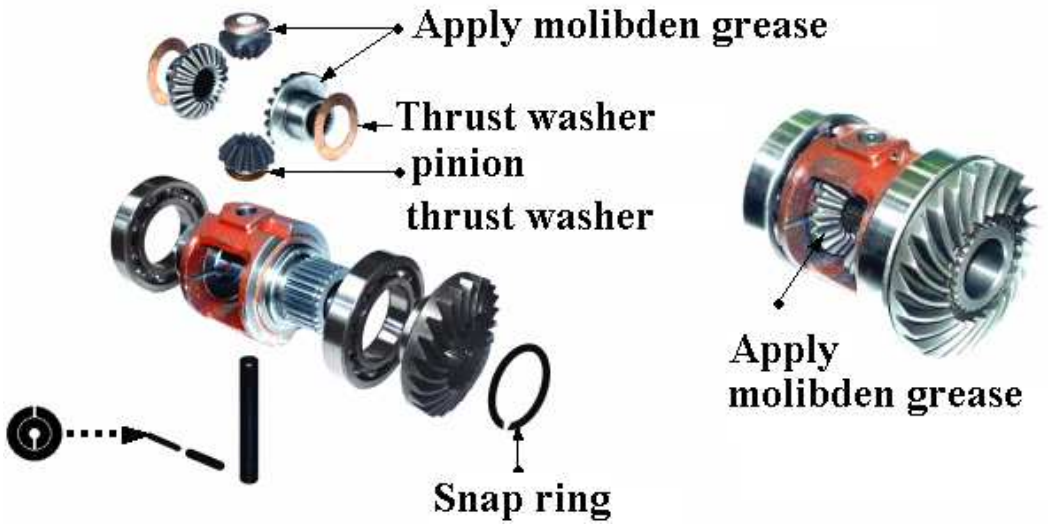
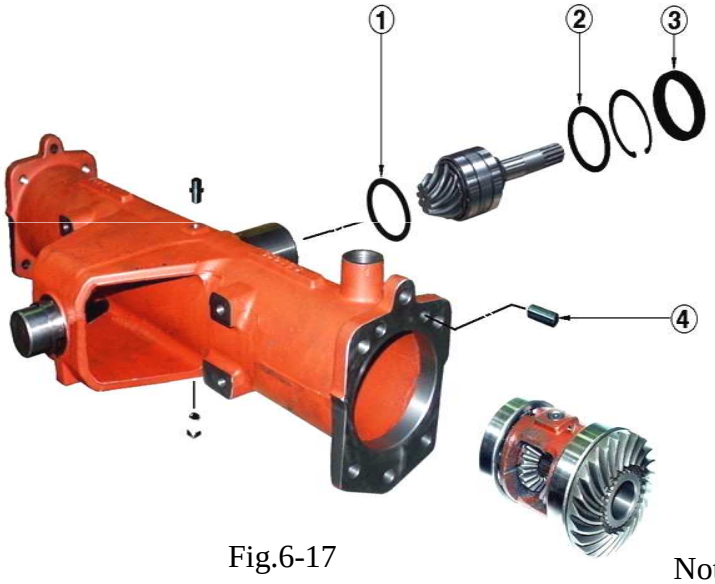


Fig.6-16

3) DIF CASE AND BEVEL PINION



1.shim

2.shim

3.shim

4.Parallel pin

Fig.6-17

1) Each friction surface should be coated with grease in advance.
2) The bevel pinion and the ring gear make a distinct pair after a mesh adjustment performed at the factory. Consequently, when reassembling the pair,be sure to pair parts with a same reference number.
3) When installing the TRB's from the bevel pinion,Be sure the calking of the lock nut and the bearings.
4) Install the snap ring and the bevel pinion can then be installed together with the TRB's (Fig.6-17)

Note: Discard the removed straight pin and oil seal and install a new pin and Oil seal when reassembled,because this pin and oil seal is apt to be damaged when removed.

5) Install the bearings from the Axle housing And the ring gear,and then the ring gear can be assembled from the Axle housing.
6) Install the straight pin(4) which retains the axle housing.
7) When any of the bevel pinion,ring gear,TRB, collar,etc.has been replaced,inspect the bevel pinion assembly for thrust play in the front axle housing through drain plug hole.

Specified thrust play mm(in)	0.1-0.2 (0.004-0.008 in)

3. FINAL CASE

3-1. Front gear case 1.

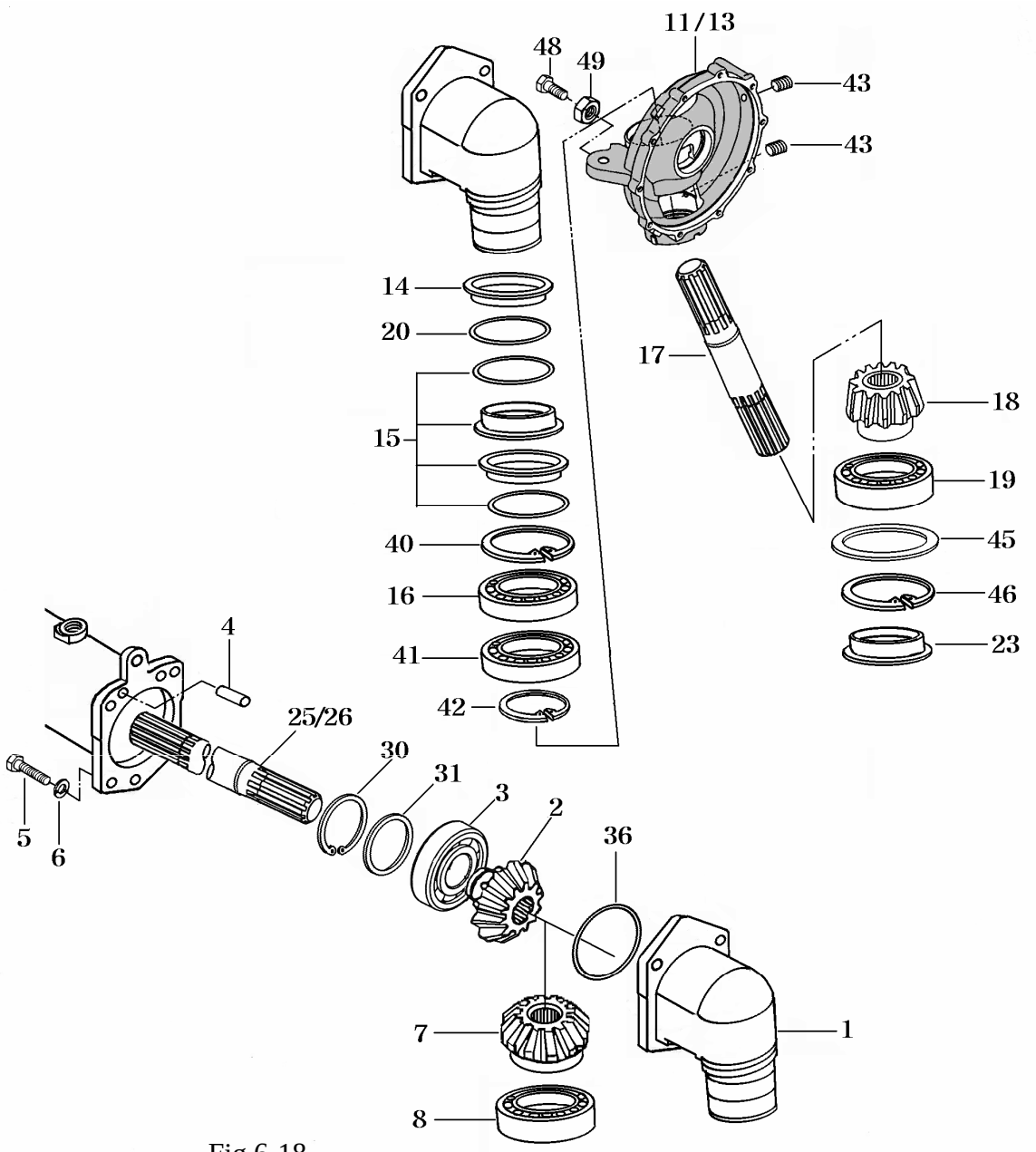
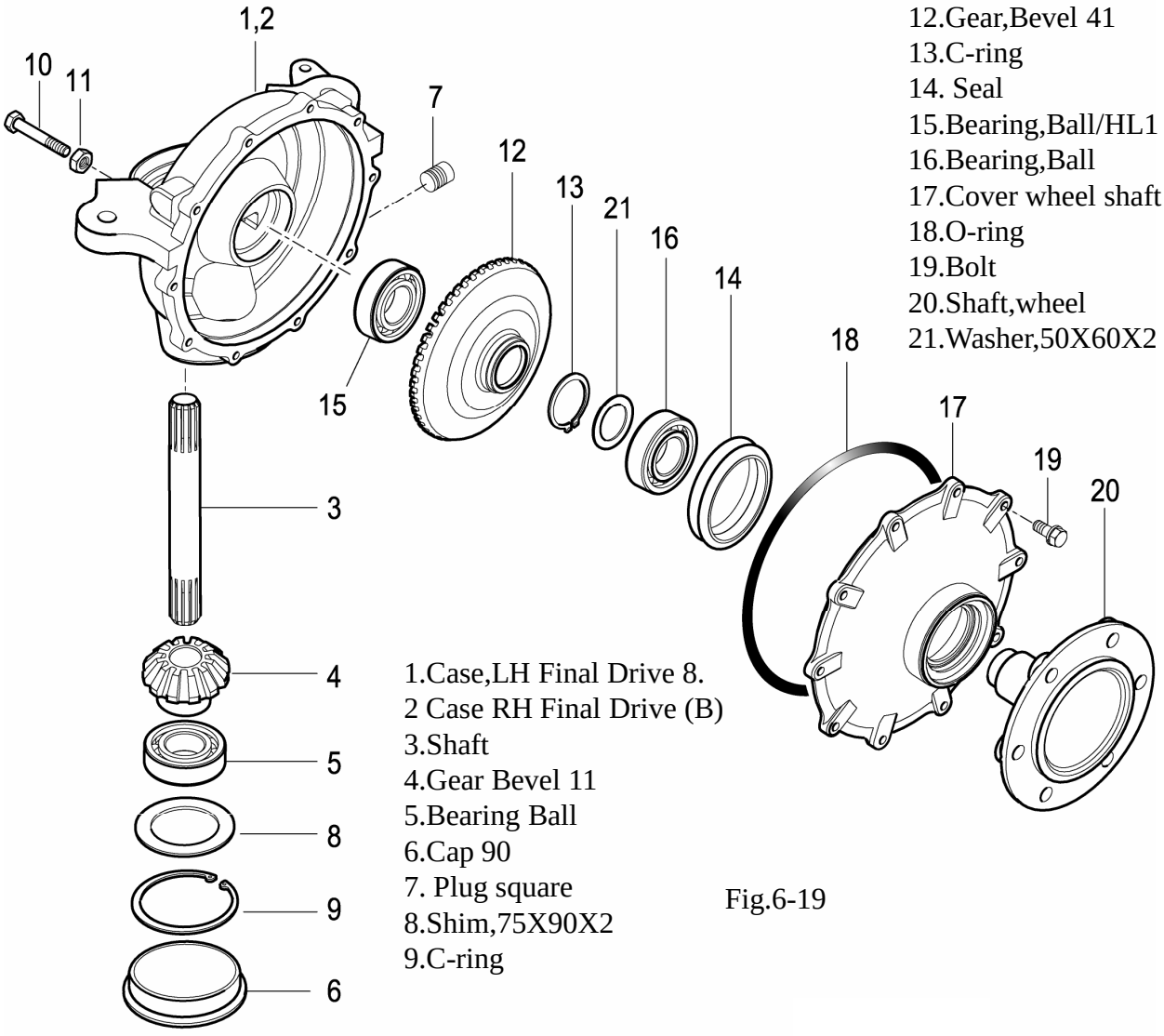


Fig.6-18

1.Final drive case(A) 2.Gear bevel(9) 3.RBB(6208) 4.Pin,parallel 5.Bolt(fine) 6.Washer spring
7.Gear bevel(16) 8.RBB(6207) 11.Final drive case(B)(L) 13.Final drive case(B)(R)
14. Housing seal 15.Seal 16.RBB(6014) 17.shaft 18.Gear bevel(12)
19.RBB(6308) 20.O-ring 23.Cap 90 25.Shaft RH(296)
26. shaft LH(480) 30.C-ring 31.collar(68X80X2) 35.Space(47.5)
40.Snap ring 41.RBB(6012) 42.Snap ring 43.Plug
45.shim 46 Snap ring 48.Bolt 49.Nut

3-2. Front gear case 2.



1.Case,LH Final Drive 8.
2 Case RH Final Drive (B)
3.Shaft
4.Gear Bevel 11
5.Bearing Ball
6.Cap 90
7. Plug square
8.Shim,75X90X2
9.C-ring
10.Bolt
11.Nut.
12.Gear,Bevel 41
13.C-ring
14. Seal
15.Bearing,Ball/HL1
16.Bearing,Ball
17.Cover wheel shaft
18.O-ring
19.Bolt
20.Shaft,wheel
21.Washer,50X60X2

Fig.6-19

3.1 Disassembly

1) Drain oil from the final case by removing the drain plug.
2) Remove the tie rod or the tie rod end.
3) Remove the final drive case clamping bolts and take out the assembly of the wheel shaft,
4) Remove the wheel shaft cover clamping bolts and cap (90)

Note: Discard the removed Cap(90) and install a new cap(90) when reassembled,because this cap is apt to be damaged when removed.

5) Detach the snap ring C from the bevel gear.
6) Extract the wheel shaft bearing together with the bevel gear,using a bearing puller

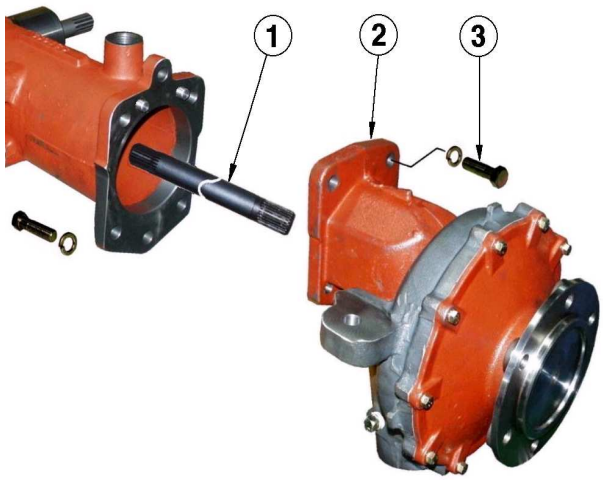


Fig.6-20

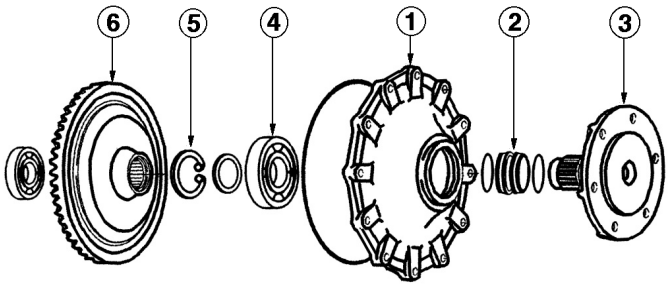


Fig.6-21

7) Remove the stop ring and the wheel shaft can be extracted.

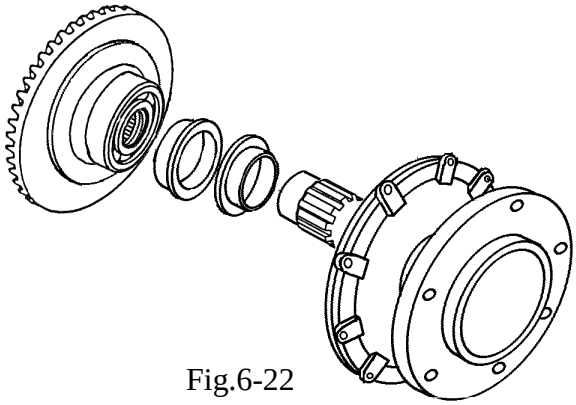


Fig.6-22

8) Remove the seal from the the wheel shaft cover

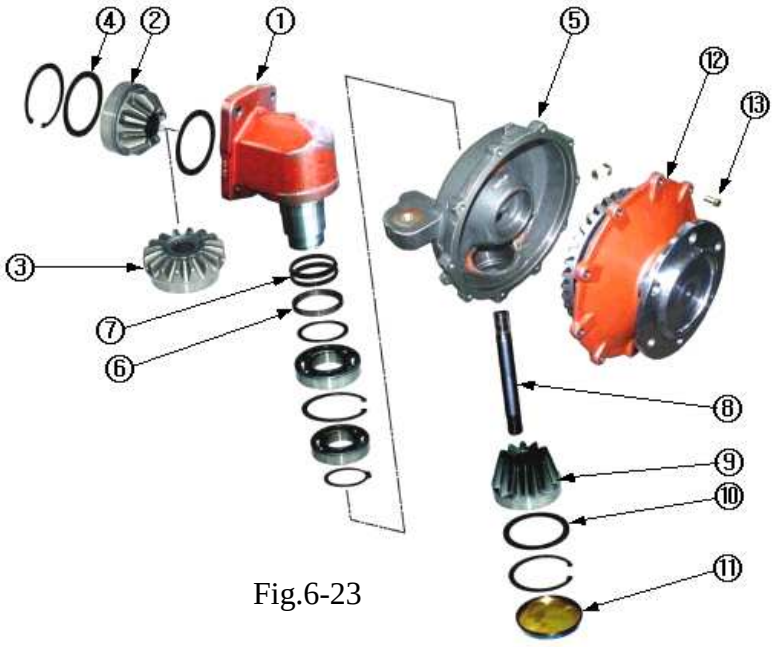


Fig.6-23

9) Remove the cap (11) from the bottom of the final case B and detach the snap ring(hole). Then the counter shaft(8) and RBB can be removed.

Note:
The removed cap(90) (black plug) should be discarded and replaced when reassembled.

3.2 INSPECTION

1) Wheel shaft cover
- Inspect mechanical oil seal,O-rings, Gears, cases,etc. and replace them if worn or damaged.
-Measure the diameter the part which makes contact with the wheel shaft,with a micro-meter or vernier-calipers.When the measured value less than the usable limit,replace the wheel shaft cover.

Standard value	62
Usable limit	62.3

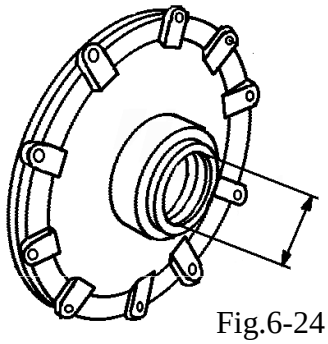


Fig.6-24

2) Final Drive case (B)
-Measure the diameter the part which makes contact with the Final drive case (A),with a micro-meter or vernier-calipers.When the measured value less than the usable limit, replace the wheel shaft cover.

Standard value	110
Usable limit	110.1

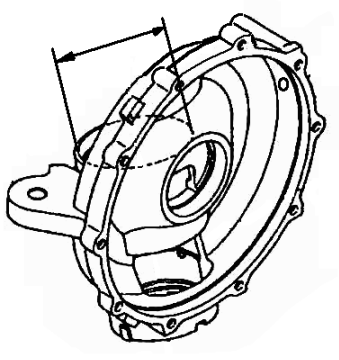


Fig.6-25

3.3 REASSEMBLY

Reassemble the parts in reverse order of disassembly, following these instructions.

1) Apply an adhesive (THREE BOND TB1215) to the following parts.
   a.Contact surfaces between the final case B and wheel shaft cover.
   b.Contact surfaces between the final case A and front axle.
2) The installed wheel shaft should turn smoothly.
3) When installing unitized seals on the wheel shaft cover and the rotating part between the final cases (A and B),apply force only to the outer circumference of the seal as shown in Fig.6-26 to avoid deformation.

Fig.6-26

4) The oil seal **should not be** coated with grease between the surface of the oil seal in advance.Then install them carefully, assuring that their lips are not turned over.
5) The reassembled final case (B) should turn smoothly until it makes contact the stopper.
6) When the wheel(tire) is reinstalled,turn it by hand to make sure that all the mechanism turns smoothly without making any noise.
7) After adjustment of the toe-in,perform road tests.There should be no abnormalities such as vibration,abnormal noises,defected steering wheel operation,etc.

-Wheel shaft cover

1) Every snap ring(5) should be seated securely in its groove.
2) Be sure the numbers of Bevel gear is correct (teeth numbers are 41)

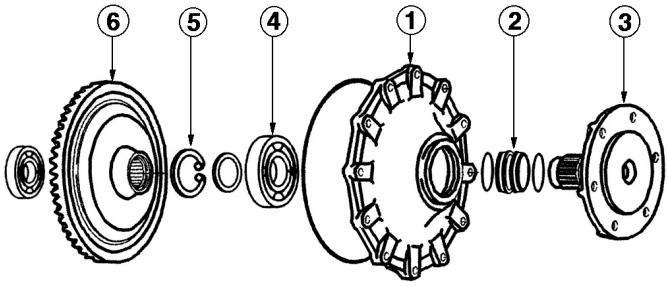


Fig.6-27

-Final drive case A

1) Each parts should be washed clean before reassembly.
2) Apply multi-purpose,quality grease to bearings in advance
3) Every time a gear and bearings are installed, its smooth rotation should be checked
4) Adjust Back lash between bevel gear 9 (2) and bevel gear 16 (3) with collar(4) .

Back lash mm(in)	0.1-0.2 (0.004-0.008 in)

5) Apply oil to the housing ahead of time to install the mechanical seal.
6) Be sure that the length of shaft (8) is 192 mm.
7) Tighten the bolts to the specified torque.

Tightening torque	130-180Kgf.cm

8) Adjust backlash between gear bevel 38 and gear bevel 11(9) with collar(10)

Back lash mm(in)	0.1-0.2 (0.004-0.008 in)

9) Apply an adhesive to the Cap (90),and be sure not to deform when installing.

Note: Refer to Fig.6-23

- FINAL DRIVE CASE AND HOUSING

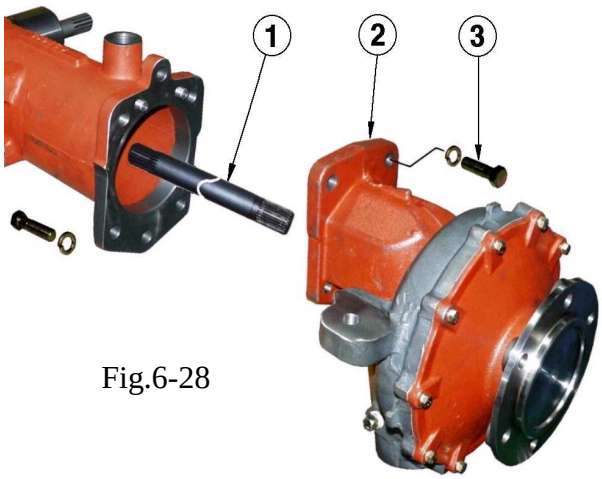


Fig.6-28

1) When installing the shaft,Be sure that the gears are not damaged.

2) Be sure the differences between the LH and RH shaft.

	LH	RH
Specified length	479mm	295mm

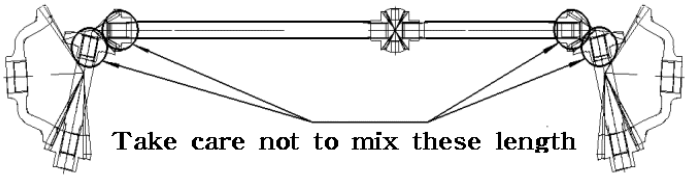


Fig.6-29

3) Tighten the bolts to specified torque.

Tightening torque	1300-1500 Kgf.cm

- STEERING CYLINDER

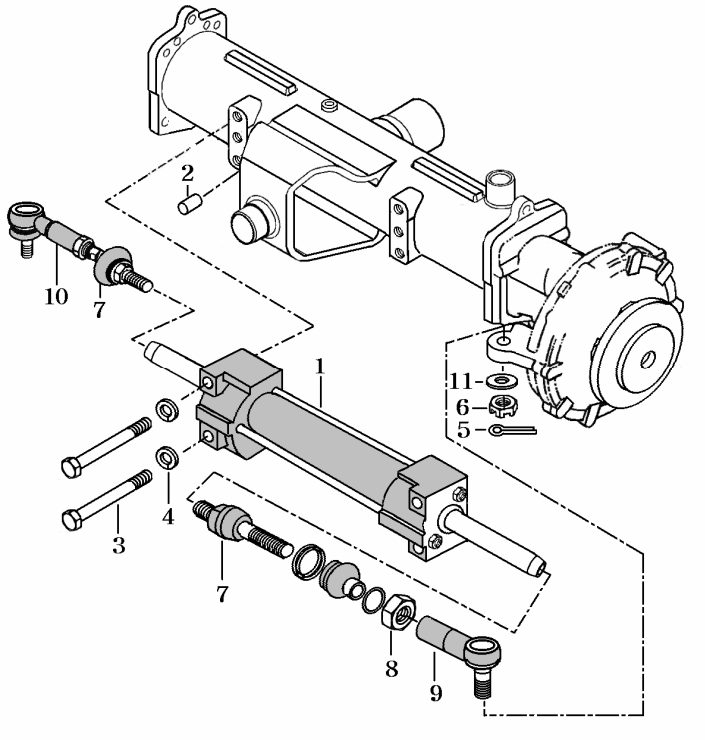


Fig.6-30

1) When installing the steering cylinder,Be sure that the rods are not damaged.
2) Install the pin(2) before assembling the cylinder.
3) Apply an adhesive Lock tite and tighten the bolts to specified torque

Tightening torque	900-1100 Kgf.cm

4) Apply an adhesive lock tite to the ball joint (7) and tighten the ball joint to specified torque

Tightening torque	1600-1800 Kgf.cm

5) Be sure to bend the split pin (5) after installing the ball joint

SECTION 4. TROUBLE SHOOTING

PROBLEMS AND PROBABLE CAUSES	COUNTERMEASURES
● Steering wheel hard to turn	
1)Too low tire inflation 2)Broken thrust bearing 3)Stuck or broken ball joint of tire-rod end 4)Seizure or poor lubrication of axle end bush	Inflate to specified value Replace Grease or replace Grease or replace
● Vibrating or pulling steering wheel	
1)Unbalanced wheels 2)Wheel deflation 3)Unequal diameter of both tires 4)Loose,worn,or damaged wheel axle bearing 5)Loose,worn,or damaged wheel steering wheel shaft 6)Worn final case bush 7)Loose final case-front axle tightening bolt 8)Loose front wheel(tire)tightening nuts1)	Adjust balance Repair or replace Adjust inflation or replace Repair or replace Retighten or replace Replace Retighten Retighten
● Steering wheel tends to turn to the right or left while traveling on straight paved road.	
1) Deflected wear of tire 2)Different tire diameters 3)Damaged final case bearing	Replace Adjust inflation or replace Replace
● Excessive or eccentric wear of tire	
1)Improper tire inflation 2)Worn front wheel shaft bearing 3)Poorly adjusted toe-in 4)Front wheel drive is always engaged	Adjust Replace Readjust correctly:2-6mm (0.08-0.24 in) Engage FWD only when required
● Noise	
1)Loose fasteners 2)Worn or damaged final case bearing 3)Worn bush 4)Wear or poor movement of tie-rod end 5)Excessive backlash of differential and bevel gear	Tighten correctly to specified torque Replace Replace Lubricate or replace Adjust
● Different steering angles in both directions	
1)Lengths of RH and LH tie-rods are different	Adjust

CHAPTER 7
Rear axle and brakes

SECTION 1.GENERAL DESCRIPTION---------- 7-1

SECTION 2. SPECIFICATIONS---------- 7-2

SECTION 3.DISASSEMBLY,INSPECTION,AND REASSEMBLY- 7-3
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1.1. Disassembly ---------- 7-4
1.2. Inspection ---------- 7-4
1.3. Reassembly ---------- 7-5
SECTION 4.TROUBLE SHOOTING---------- 7-7

Chapter 7. Rear axle and brakes

1. GENERAL DESCRIPTION

The rear axle system is of the central axle type,which contains the final reduction gears, differential gears with diff-lock,and brakes.The power from the engine is transmitted to the right and left wheel pinions through the differential gears,and reduced in the revolution to the rear wheels by the wheel gears. A wet,multi-Disc, mechanical operated brake system is employed.Each of the brakes has 2 friction plates and can produce significant braking force with excellent durability. The two actuators work to push their friction plates in opposite directions,that is,outward,so that stable braking force can be realized in both forward and reverse movements of the tractor. A dif-lock mechanism which is housed in the right-hand rear axle housing is employed to lock the differential gears and is activated by depressing the dif-lock pedal,resulting in the same rotary speeds of both wheels.

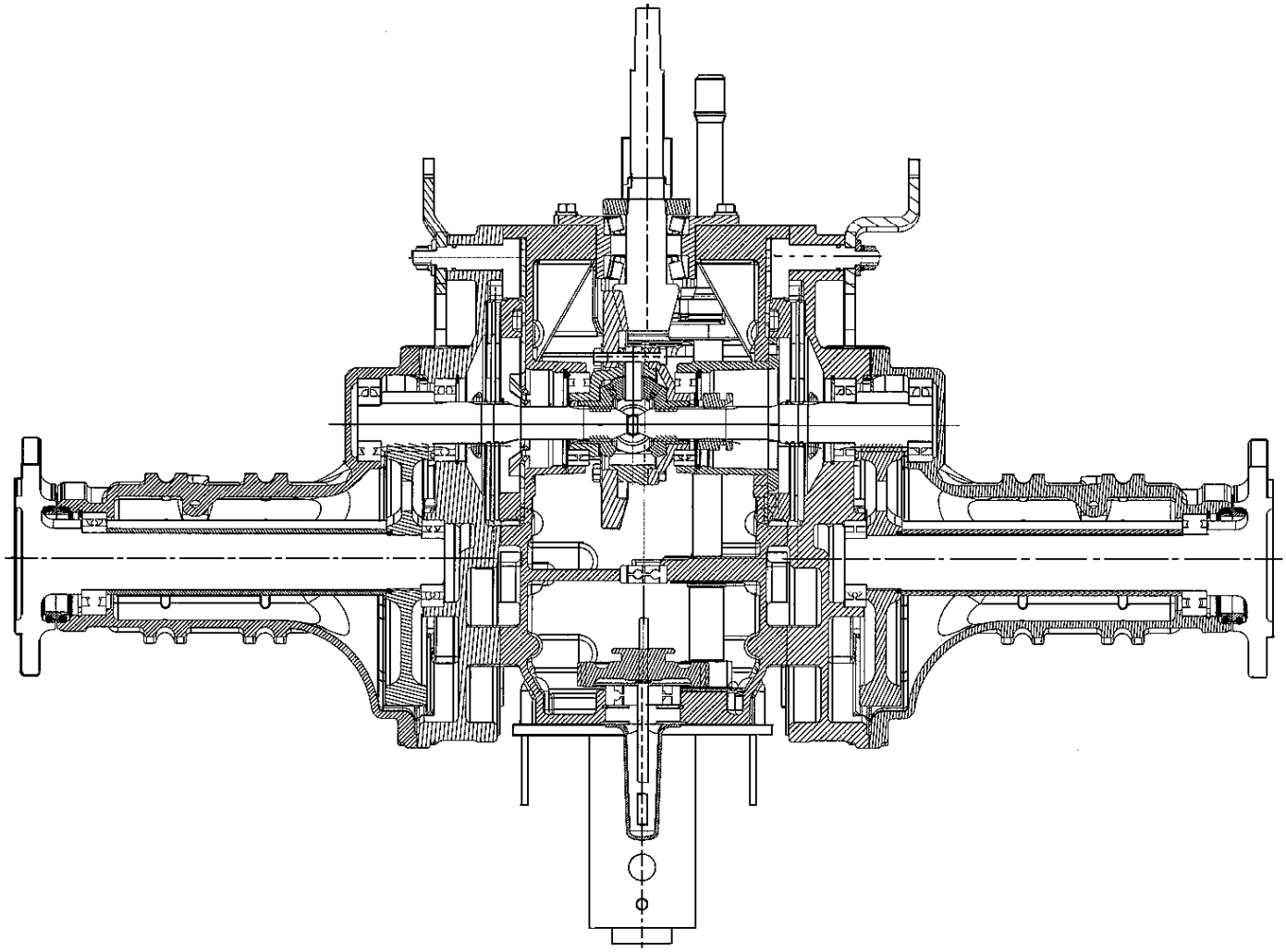


Fig.7-1

SECTION 2. SPECIFICATIONS

MODEL			T303HST/T353HST
Final reduction gears		Type	Helical gears
		Reduction ratio	0.1852 (10/54)
Brake system	Friction Plate	Type	Wet,multi-disc,Mechanically operated
		Outer diameter	Φ210 mm
		Thickness	4.7 mm
		Lining material	Paper
		Number of plates	2 on each side
	Separator Plate	Outer diameter	Φ212 mm
		Thickness	2.5±0.09 mm
		Number of plates	1 on each side
		Metal brake assembly Installed thickness	18 mm
		Total brake thickness	29.9 mm

SECTION 3.DISASSEMBLY,INSPECTION,AND REASSEMBLY

Separate the rear axle housing from the rear transmission referring to paragraph 6.(1) of SECTION 4. SEPARATION OF MAJOR BLOCKS in Chapter 2

1 REAR AXLE HOUSING AND BRAKE SYSTEM

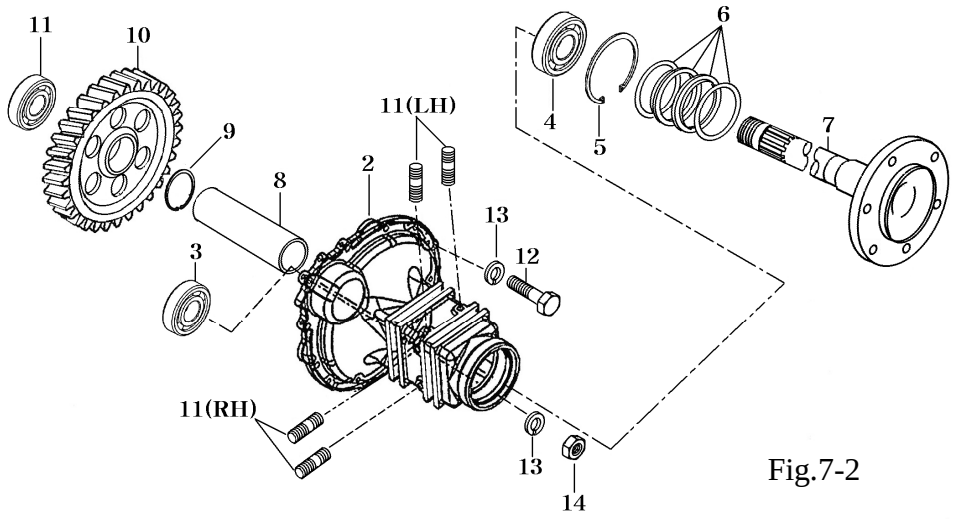
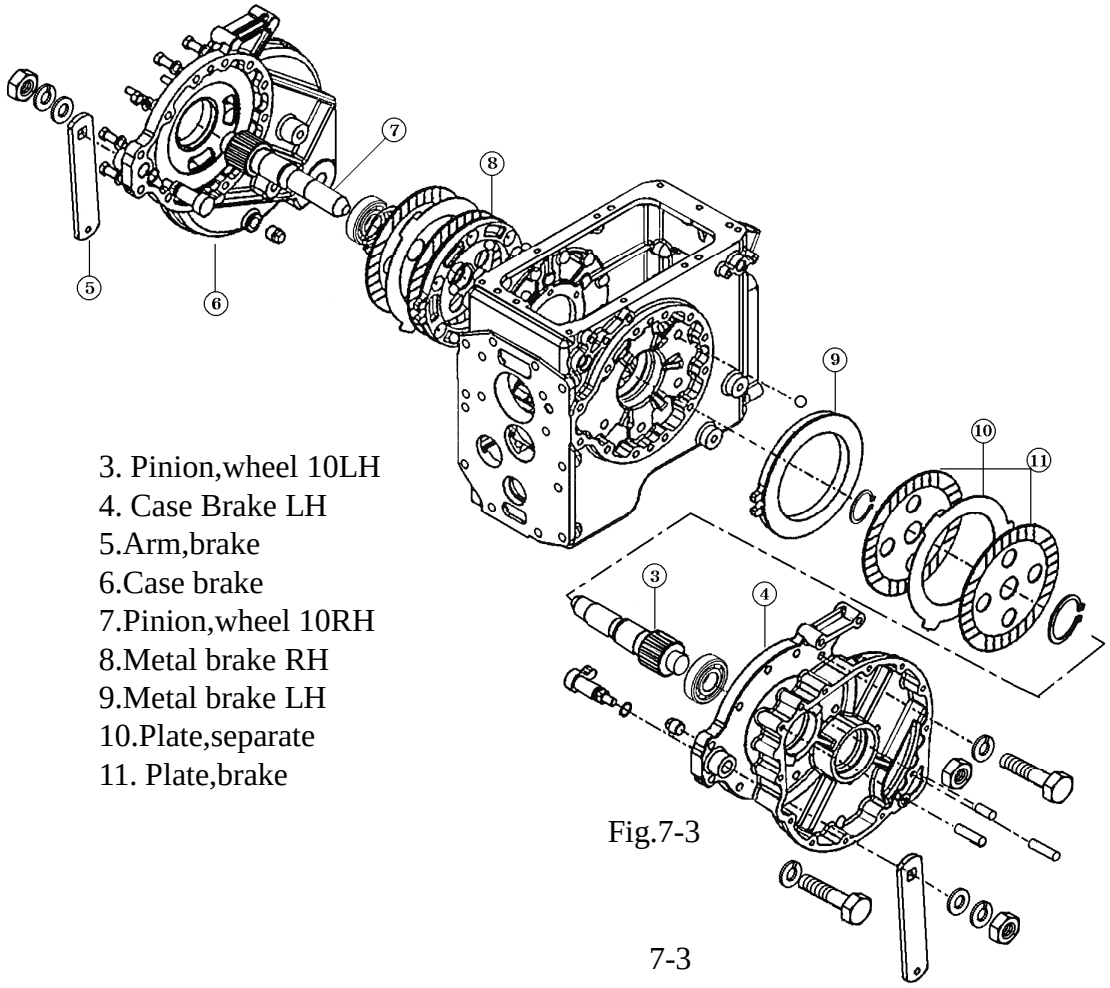


Fig.7-2

2.Housing rear axle
3.Bearing,Ball(6307)
4.Bearing,Ball(6211)
5.Snap ring
6.Mechanical seal
7.Wheel shaft
8.Collar(56X65X239)
9.Stop ring
10.Gear,helical/54
11.Bearing Ball (6209HL1)
12.Bolt
13.Bolt
14.Washer,spring
15.Nut



3. Pinion,wheel 10LH
4. Case Brake LH
5.Arm,brake
6.Case brake
7.Pinion,wheel 10RH
8.Metal brake RH
9.Metal brake LH
10.Plate,separate
11. Plate,brake

Fig.7-3

1.1 Disassembly

1) Release the bolt and nut and remove them.
2) Extract the bearing(11) with a puller and remove wheel gear(10)

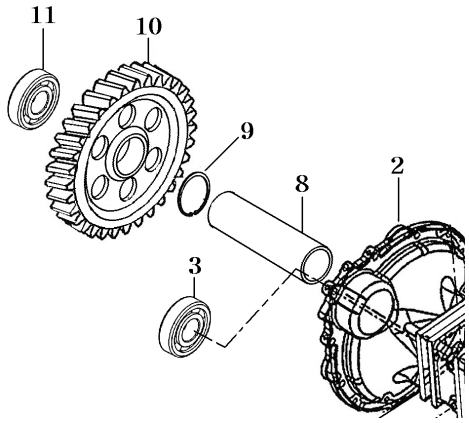


Fig.7-4

3) Remove the snap ring (9) ,collar (8) and pull out wheel shaft (7)

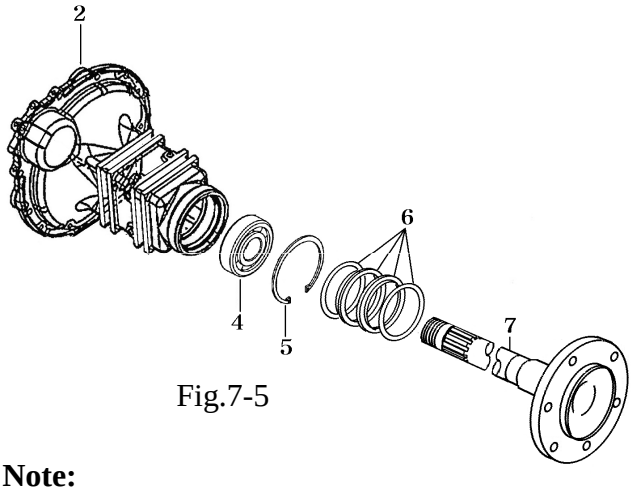


Fig.7-5

Note:

Removed oil seal(6) should be replaced with a new one when reassembled

4) Remove the brake metal tightening bolts and remove brake metal(4) with wheel pinion(3) and disc brake assembly on it.

5) Remove the snap ring of wheel pinion(3) (Fig.7-6) And individually separate the friction plates, metal brake,cam brake,and separator plates(11) from each other.
6) The cam brake can be disassembled by removing Nut.

Note:

Be careful to keep the friction surfaces of the linings,
brake metals free from damage and foreign matter.

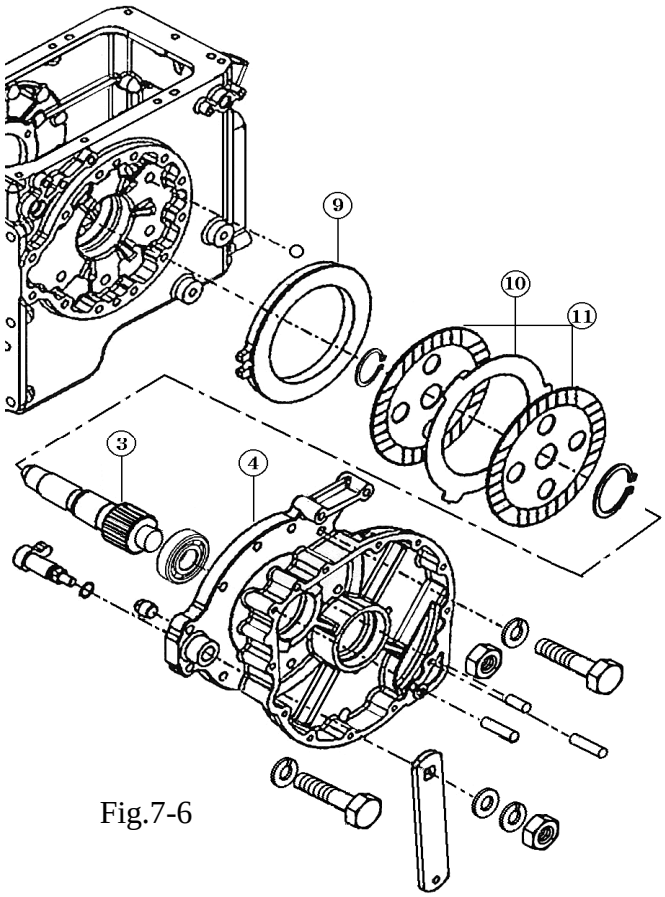


Fig.7-6

1.2. INSPECTION

1) Friction plates.
Replace the plates whose surfaces have been become glossy by carbonization or whose thickness exceeds the usable limit.

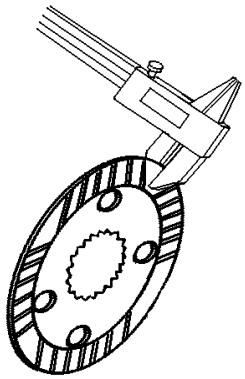


Fig.7-7

Standard thickness:mm(in)	4.7 (0.185)
Usable limit:mm (in)	4.3((0.169)

Note:

Also replace those whose grooves have been worn out completely even if only on one side

2) Metal brake

Check the pressure plate,and brake rod for abnormality.Replace defective parts.Replace the metal brake whose thickness exceeds the usable limit.

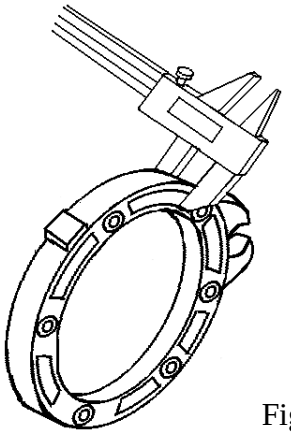


Fig.7-8

Standard thickness:mm(in)	18(0.708)
Usable limit:mm (in)	17.5((0.688)

Note:
Slight scratches on the friction surface can be corrected with sandpaper(#1000)

3) Separator plate.
Measure the thickness and replace the plate whose thickness exceeds the usable limit or whose surfaces are damaged (Fig.7-9)

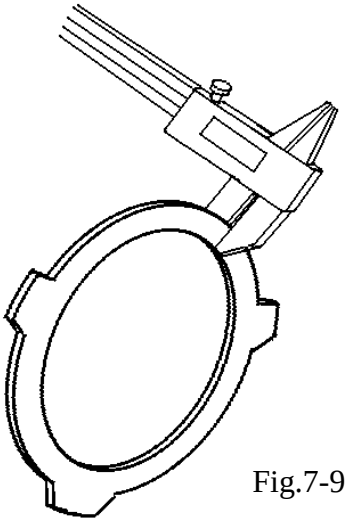


Fig.7-9

Standard thickness:mm(in)	2.5±0.09 (0.098)
Usable limit:mm (in)	2.2(0.087)

4) Wheel shaft

Check the shaft for abnormalities like wear, damage,etc,and replace a defective one.

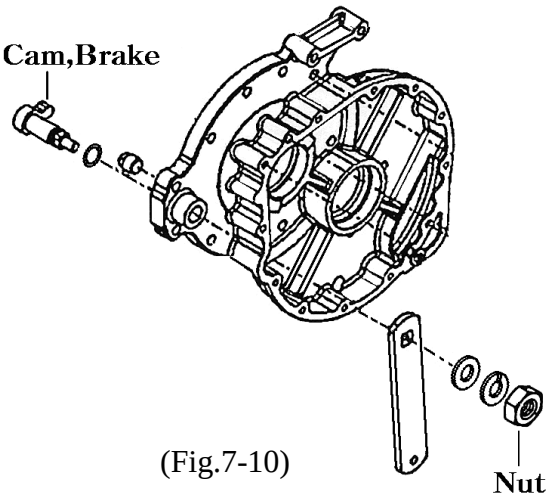
5) Bearings
Check them for abnormalities like hitching, irregularity,etc.in rotation after being washed clean.Replace defective ones.

6) Oil seals
Removed oil seal should be replaced with a new one when reassembled.

1.3 REASSEMBLY.

Reassemble the parts in reverse order of disassembly ,follow these precautions.

1) Make sure that oil grooves,friction surfaces,etc of the brakes are free from matter such as dust, iron powder,etc.to avoid brake lining damage.
2) When installing the brake unit on the wheel pinion,friction plates and separator plates should be arranged in correct order and never forget to retain the unit with the snap ring.
3) Cam brake tightening nuts should be tightened to the specified torque with a torque wrench. (Fig.7-10)



(Fig.7-10)

4) Replace the oil seal.

Install the bearing,snap ring,and collar into the axle housing,and then press in the oil seal by applying force only to the circumference as shown in the figure(Fig.7-11)

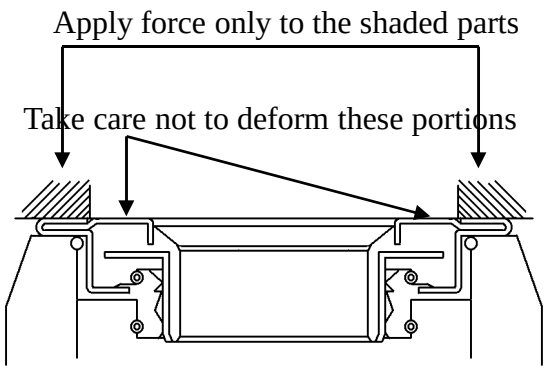
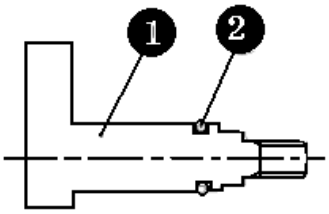


Fig.7-11

5) press the wheel shaft.
6) Install the wheel gear and bearing on the wheel shaft and retain them.
7) Apply adhesive (THREE BOND 1215) to the contact surfaces of the brake metal and housing and then retain the plates by tightening the nuts to the specified torque.

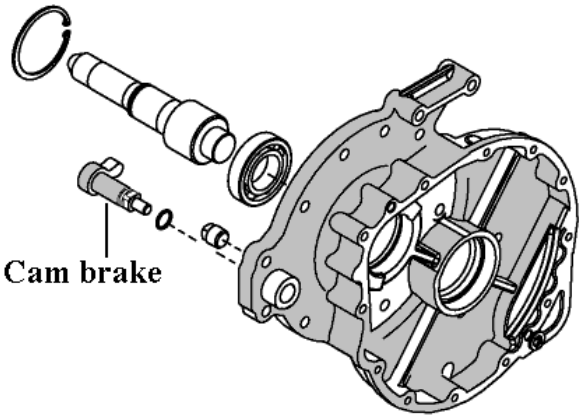
Tightening torque	0.6-0.8 Kgf.m (4.3-5.8ft-lbs)

-Cam brake



1.Cam brake

2. O-ring



-Brake case

1) When installing the brake disc,Disc plate and separator should be arranged in correct order.
2) Apply an grease to the O-ring and take care not to be damaged when installing to the brake cam.
3) pay particular attention to the installation of the snap ring
4) The assembled wheel pinion should rotate smoothly.

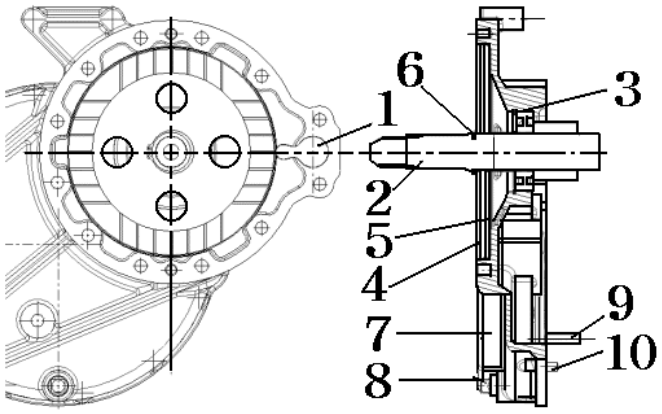


Fig.7-12

SECTION 4. TROUBLESHOOTING

Problem	Causes	countermeasures
1) Rear axle		
Noises	· Worn or damaged bearing · Worn gear or wheel shaft	Replace Replace
2) Brake system		
(1)Insufficient braking force	· Insufficient depressing of brake pedals · Improper pedal free play · Worn friction plates	Depress pedals positively Adjust Replace
(2)Brake noise	· Insufficient brake oil · Broken actuator spring · Eccentric wear of actuator	Replenish Replace Replace
(3)Brake overheating	· Insufficient oil · Excessive pedal free play · Improper operation	Replenish Adjust Operate brakes properly
(4)Brake cannot be disengaged completely.	· Improper brake pedal free play · Broken actuator spring · Broken pedal spring	Adjust Replace Replace
(5)Not uniform braking	· Improper free play adjustment · Worn actuator ball	Adjust Replace
(6)Excessive pedal play	· Improper adjustment of brake rod · Worn actuator-fork tightening bolt · Worn brake shaft or brake arm	Adjust Replace Replace

Chapter 8
Power assisted steering system

SECTION 1.GENERAL DESCRIPTION---------- 8-1

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2.2 Steering valve ---------- 8-2
2.3 Oil tank---------- 8-2

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4.5 Reassembly ---------- 8-8

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Chapter 8. Power assisted steering system.

SECTION 1. GENERAL DESCRIPTION

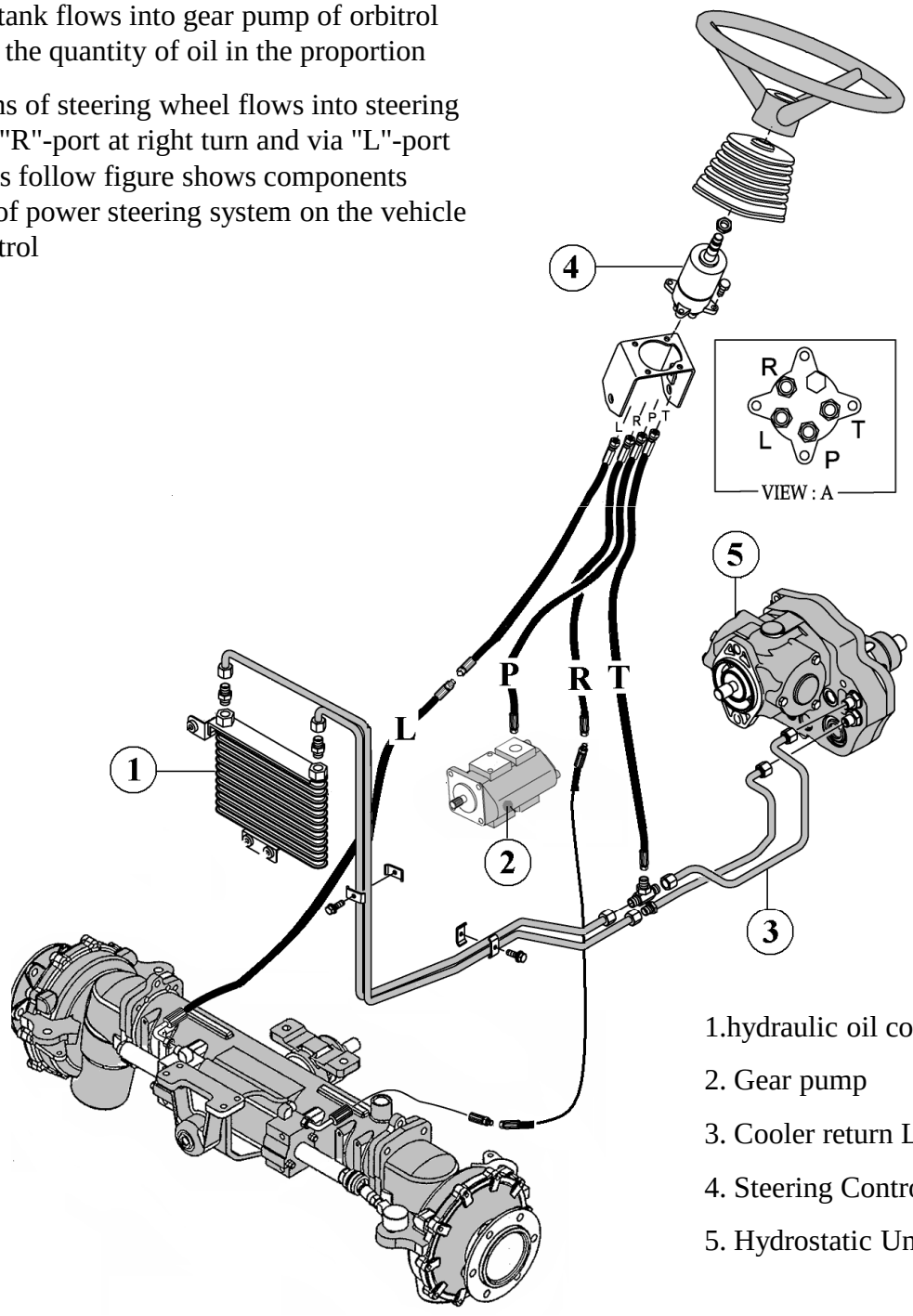
The hydraulics of this power-assisted steering system are actuated by a specially designed steering valve system.

Non Load reaction valve blocks the L,R cylinder ports in neutral condition and does not transmits the reaction load of the tire to the steering wheel in neutral.Generally the system is used for the vehicles that treat heavy equipment or low speed traveling.

Hydraulic circuit consists of Independent system.

The oil from tank flows into gear pump of orbitrol via filter, and the quantity of oil in the proportion

to the rotations of steering wheel flows into steering Cylinder Via "R"-port at right turn and via "L"-port at left turn .As follow figure shows components composition of power steering system on the vehicle with the Orbitrol



1.hydraulic oil cooler

2. Gear pump

3. Cooler return Line

4. Steering Control Unit

5. Hydrostatic Unit

Fig.8-1

SECTION 2. SPECIFICATIONS

1) GEAR PUMP

MODEL	T303HST/T353HST
Delivery (cc/rev)	6.5
Maximum pressure (kgf/㎠)	180
Rated operation speed (rpm)	500~3500
Rotation direction	C.C.W as viewed from shaft

2. Power steering valve Unit(orbitrol)

MODEL	T303HST/T353HST
Model number	OSPM 80 ON
Displacement (cc/rev)	80
Rated flow (ℓ/min)	7~20
Maximum system pressure (kgf/㎠)	180
Max. back pressure (kgf/㎠)	20
Max. temperature(℃)	90
Input torque (N.m)	0.8~1.5
Inlet relief pressure setting (kgf/㎠)	110~115
Recommended filtration (ISO4406)	22/20/17
Weight (kgf)	2.7

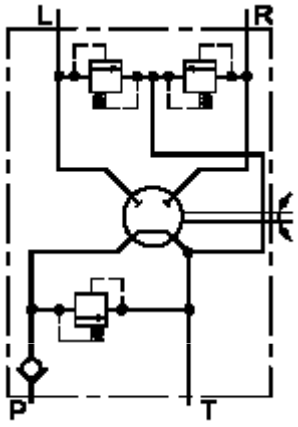
3. OIL TANK

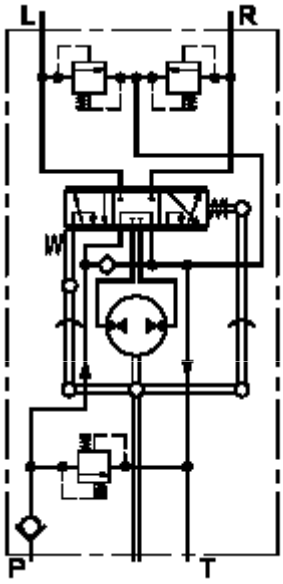
MODEL	T303HST/T353HST
TANK	TRANS MISSION
Fluid volume (ℓ)	35
Fluid	THF500

SECTION 3. FUNCTION

OSPM is a hydrostatic steering unit which can be used with an add-on steering column, OTPM/OTPM-T or with the steering column integrated with the unit.
The steering unit consists of a rotary valve and a rotary meter.
Via a steering column the steering unit is connected to the steering wheel of the vehicle. When the steering wheel is turned, oil is directed from the steering system pump via the rotary valve and rotary meter to the cylinder ports L or R, depending on the direction of turn. The rotary meter meters the oil flow to the steering cylinder in proportion to the angular rotation of the steering wheel.
If the oil supply from the steering system pump fails or is too small, the steering unit is able to work as a manual steering pump.

OSPM-ON
Open center steering units have open connection between pump and tank in the neutral position.





3.1 TECHNICAL DATA OSPM

Max. input flow			20 l/min [5.28 US gal/min]
Ambient temperature		Min.	–30˚C [–22˚F]
		Max.	+60˚C [140˚F]
Surface treatment	Permissible temperature assuming non-activated steering unit		120˚C [248˚F] for 20 minutes
Oil temperature		Min.	-30 ˚C [-27˚F]
		Max.	+90 ˚C [194˚F]
Oil viscosity		Min.	4 mm2/s [40 SUS]
		Max.	1000 mm2/s [4629 SUS]
Filtration	Max. degree of contamination ISO 4406	ON	22 / 20 / 17
		PB	22 / 20 / 17
Steering torque	Normal steering		0.8-1.5 Nm [7.08-13.3 lbf·in]
	Manual steering		Max. 80 Nm [708 lbf·in]
	Momentary load		Max. 160 Nm [1416 lbf·in]

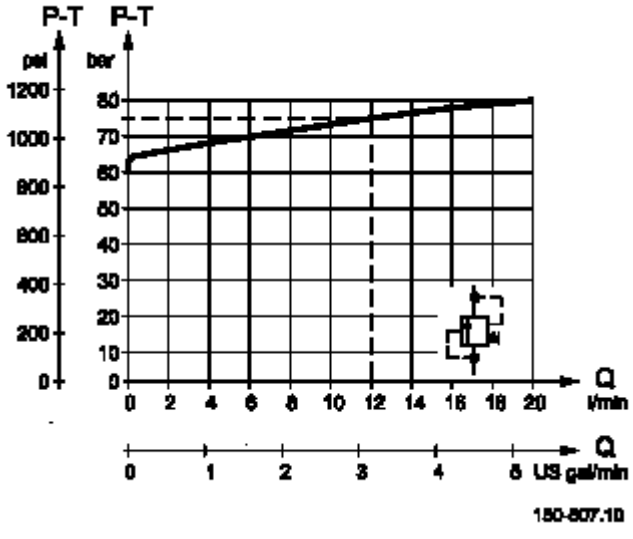
MANUAL STEERING PRESSURE

Under normal operating where the steering pumps supplies an adequate oil flow at the required pressure, the maximum torque on the steering wheel will not exceed 2 Nm[17.7 lbf·in]. If the oil flow from the steering system pump fails or is too small, the steering unit functions automatically as a manual steering pump. Manual steering can only be used for a limited control of the vehicle if a sudden drop of pump pressure occurs.The Pm 50bar[725 psi] shows the manual steering pressure (Pm) for all sizes of Sauer-Danfos steering units type OSPM at a steering wheel torque of 80 Nm [708 lbf·in].The values apply only if the suction conditions on the steering unit T port are adequate.

PRESSURE RELIEF VALVE

The pressure relief valve protects the pump and steering unit against excess pressure and limits the system pressure while steering.

The pressure relief valve in the steering unit will limit the maximum pressure drop from P to T. The pressure relief valve is set at 12 l/min[3.17 US gal/min] flow.



SHOCK VALVES

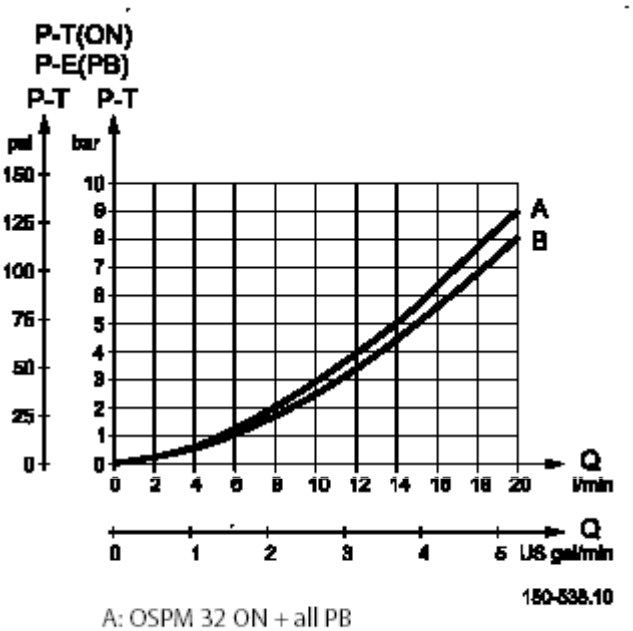
The shock valves protect the steering unit against shocks from external forces on the steering cylinder. The shock valves in the steering unit limit the max pressure drop from L to T and from R to T. The shock valves are set at 1 l/min [0.27 US gal/min]. They are of the direct type and therefore have a very quick reaction. The setting tolerance is +20 bar [+290 psi].

CHECK VALVE

The check valve protects the driver against kickbacks in the steering wheel. It prevents the oil from flowing back into the pump line during steering under high pressure on the cylinder side. The check valve is mounted in the P-connection of the steering unit.

PRESSURE DROP IN NEUTRAL

The pressure drop is measured with the steering unit in neutral position.On the OSPM ON the pressure drop is measured from P to T. The values are valid at an oil temperature of 50°C [122°F] and a viscosity of 21 cSt [100 SUS].



A: OSPM 32 ON + all PB
B: OSPM 50-100 ON

SECTION 4. Disassembly,Inspection,And Reassembly

1. Major component of steering valve (orbitrol)

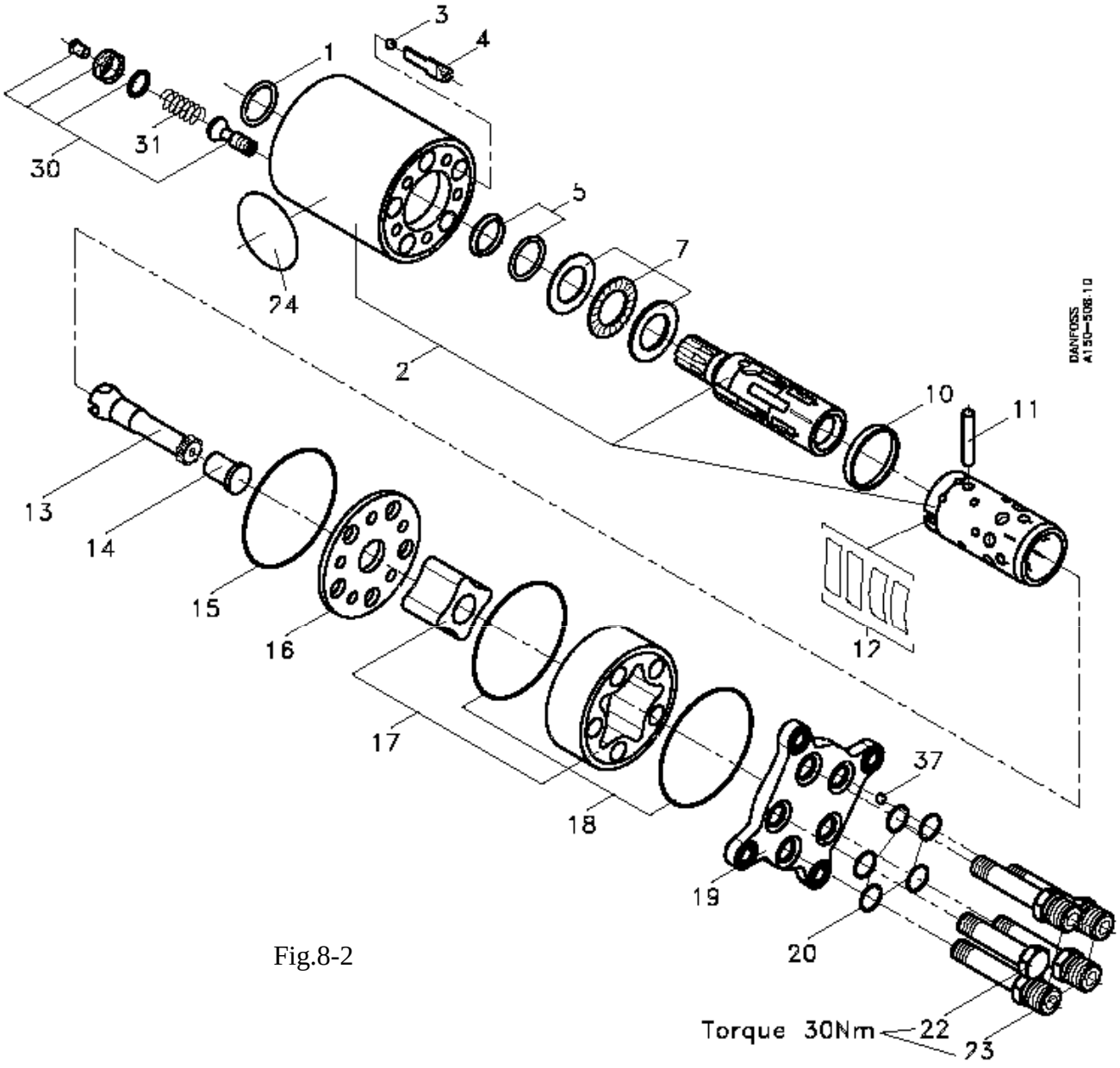


Fig.8-2

1.Dust seal ring 2. Housing spool and sleeve 3.Ball 4. Ball stop 5.Shaft seal 7.Bearing 10.Ring

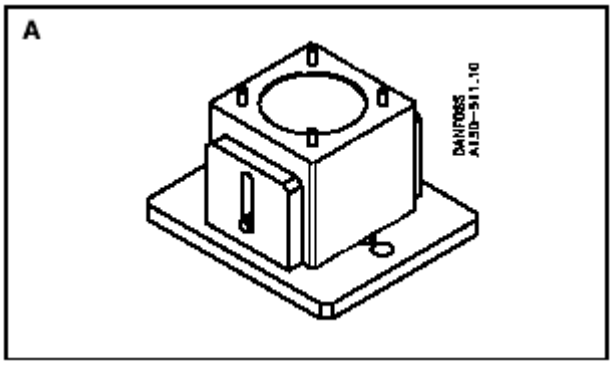
11. Cross pin 12.Set of springs 13.Cardan shaft 14.Spacer 15.O-ring 16. Distributor plate

17.Gear wheel set 18.O-ring 19.End cover 20.O-ring 22.Special screw 23. Special screw

24. Name plate 30.Complete relief valve.

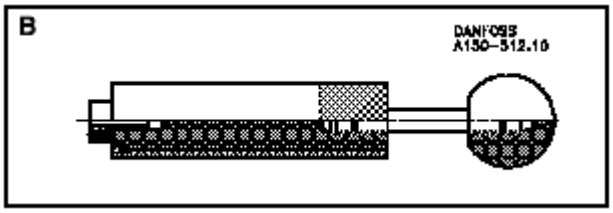
2.SPECIAL TOOLS

A.Holding tool, code no. SJ150L9001-01



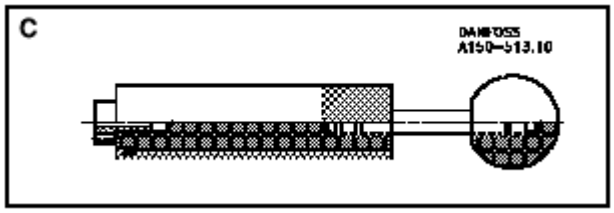
B . Assembly tool for shaft seal ø17.5,

code no. code no. SJ150L4011 - 01



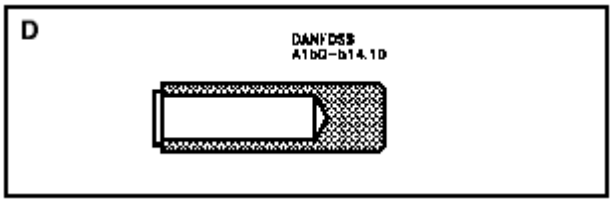
C. Assembly tool for shaft seal ø19,2,

code no. SJ150L4012 - 01



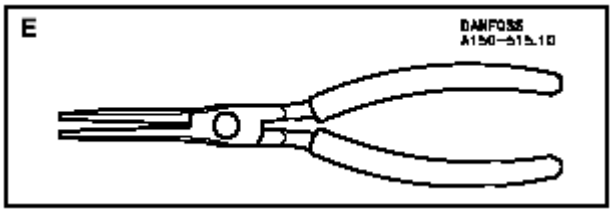
D . Assembly tool for dust seal ring,

code no. SJ150L0396 -01

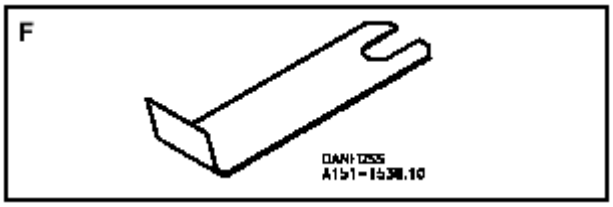


E. Pliers for piston in pressure relief valve,

code no. SJ150-9000 -25



F. Fork for fitting cardan shaft (OMM)
SJ 151G9000 -1



G . Ordinary hand tools.

Socket spanner (5/8 in)

Ratchet spanner, 1/2”

Torque wrench: 0-70 Nm (0-7 da Nm)

Allen keys: 5 & 8 mm a/flats

Small screwdriver, ground sharp.

Pincers

3. Disassembly

Separate the orbitrol referring to Fig.8-2 of SECTION .Disassembly,Inspection,And Reassembly 1.Major component of steering valve (orbitrol)

STEP 1.

- Column

If there is a steering column on OSPM, place the unit in the holding tool, on the **four locating pins** with steering column upwards. Dismantle the steering column.

STEP 2.

-Pressure relief valve (30, 31)

If there is a pressure relief valve in OSPM, remove the plastic plug from the adjusting screw and unscrew with the 5 mm a/flats Allen key. Remove the spring and use special pliers-lift the valve cone out of the housing.

Lift OPSM clear of the holding tool, turn it so that the output shaft points downwards and place it in the holding tool again.

Note, the locating pin in the tool must engage with the OSPM housing.

STEP 3.

-Special. Screws (22, 23)
Remove the screws with a 16 mm a/flats (5/8") spanner.

-End cover (19)
Remove end cover sideways.

STEP 4.
-Gear wheel set (17, 18)
Hold a hand under the gearwheel set to keep the gearwheel from falling out.
Remove O-rings.

STEP 5.
-Distributor plate (16)
Remove distributor plate.

-Cardan shaft (13)
Remove cardan shaft.

STEP 6.
-O-ring (15)
Remove O-ring from housing.

-Balls and ball stop (3, 4, 37)
Shake out check valve ball (not in all units), ball stop and emergency steering ball. Use pincers if necessary.

STEP 7.
Place the OSPM in the tool again. Lift up steering unit and fixture in one piece and turn it 90˚ to horizontal.

-Housing/spool/sleeve (2)
Turn the spool set so that the pin in spool and sleeve is horizontal and push it out

STEP 8.
-Bearing (7)
Remove bearing from shaft end.
The outer washer may sometimes adhere to the housing. If the washer does not come out with the shaft, it will come out when shaft seal item 5 is being pressed out.

-Ring(10)
Remove retaining ring for the neutral position springs.

STEP 9.
-Cross pin(11)
Press the pin out of the spool set.
Carefully press the spool out of the sleeve.

-Springs (12)
Press the neutral position springs out of the spool.

-Dust seal (1)
Remove the dust seal ring (with a "sharp" screwdriver).

-Shaft seal (5)
Remove the shaft seal
(with a "sharp" screwdriver if necessary).

4. Cleaning, inspection,replacement and lubrication

Note:
a.Clean all parts carefully.
b.Carefully check all parts and replace imperfect parts, if any.
c.Always replace all sealing parts during a repair.
d.Before assembly, lubricate all parts with hydraulic oil and grease rubber parts with Vaseline.

5.REASSEMBLY

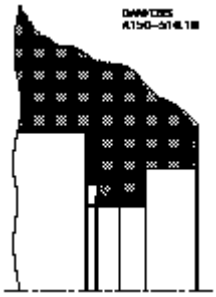
STEP 1.
-Housing (2)
Place the OSPM housing horizontally in the holding tool, with the hole for the output shaft facing the tool.

Note: the locating pin in the tool must engage with in the OSPM housing.

STEP 2.
-Shaft seal (5)

With the assembly tool the shaft seal must into the housing.
Note that the small guide piece at the front of the tool must remain in the hole for the output shaft when the tool itself is drawn out of the housing.

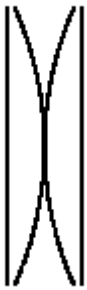
Note: there are two different tools:
One for housings for steering column mounting (SJ150L4011-01)
One for housings with integrated steering column (SJ150L4012-01).



STEP 3
-Spool/sleeve (2)
Guide spool and sleeve together, turn the spools so that the key slots are opposite each other.

STEP 4.
-Springs (12)

Insert the curved springs between the flat springs and push them into place (see sketch).



STEP 5.

Spring retaining ring (10)

Center the springs in the spool/sleeve set and guide the ring down over the sleeve.

Note: The ring must be able to rotate unimpeded by the springs.

STEP 6

-Cross pin (11)
Fit the cross pin in the spool set.

-Thrust bearing (7)
Fit the thick race, needle cage and thin race.Lubricate the output shaft on the inner spool with Molykote PG plastslip 75,on the surface in contact with the shaft seal.

STEP 7
-Housing /spool/sleeve (2)

a.With the housing still horizontal in the holding tool - secure it with one hand. With the other hand take the assembled spool/sleeve set, making sure two fingers hold the cross pin (11) in position. Guide the spool set into the housing with the cross pin (11) horizontal.

Note:
Be careful with the small guide piece from mounting of the shaft seal.
With it is pressed out by the shaft rotary.

b. With housing and spool set remaining in the tool,lift the whole unit into vertical position. The pin in the spool set must now point towards port P in the housing, either at 6 o'clock or 12 o'clock.

STEP 8.

-Ball (3)
Place the emergency steering ball in port P.

-Ball stop (4)
Place the ball stop in port P.

-Ball (37)
Place the check valve ball (if required) in port P

STEP 9.

-O-ring (15)
Fit the O-ring in the housing.

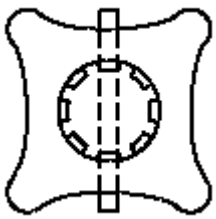
-Distributor plate (16)
Place the distributor plate on the housing.
Turn it so that the holes line up.

STEP 10
-Cardan shaft(13)
Fit the cardan shaft into the inner spool and allow it to engage with the pin.

If so required use fork SJ 151G9000-1to retain the cardan shaft.

STEP 11
17 Gear wheel
When fitting the gearwheel, it must be oriented correctly so that it engages with the cardan shaft.

The cross pin (11) in the spool set must line up with the bottom of the teeth in the star
(see sketch).



STEP 12
-O-rings (18)
Place the O-rings in the grooves on each side of the gearwheel rim.

-Gear ring (17)
Place the gearwheel rim over the distributor plate so that all holes are in line with each other.

STEP 13.
-Spacer (14)
Place the spacer over the cardan shaft.

-End cover (19)
Place the cover so that the hole marked “P” lines up with port P in the housing(“6 o’clock ” or “12 o’clock”).

STEP 14.
-Special screws (20, 22,23)
Fit screws (with O-rings). Remove the retainer fork. Tighten all five screws (cross pattern) with 30 ± 3 Nm (3 daNm).

Note:
With open center units, the screw with no oil flow connection must be fitted in port E.

If the OSPM must be mounted with a Pressure relief valve, lift it out of the tool and place it on the four pins with the axle journals upwards.

STEP 15.
-Piston (30)
Fit the piston.
-Spring (31)
Fit the spring.

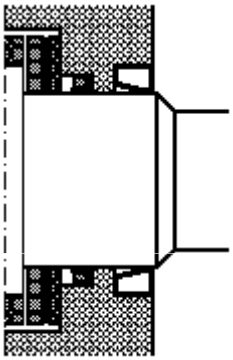
STEP 16.
-Adjustment (30)
Screw in the adjusting screw.

STEP 17. (Test)

a.Lift OSPM out of the tool and prepare it for testing.
The pressure relief valve can be set either on a test panel or in a system with pressure-gauge read-off.
b.Insert plastic plug.

STEP 18.
Dust seal (1)
Guide the dust seal ring down over the shaft end press into place in the housing with assembly tool. SJ 150L0396 - 01.

Note: The dust seal must be fitted after testing so that any leakage from the shaft seal can be detected.



SECTION 5. TROUBLESHOOTING

Problems and probable causes	Counter measures

1. Steering wheel is very heavy to turn

1) Poor assemble between steering column and unit.	
(1)Spline of column and unit are assembled tightly.	-Replace column spline
(2)Spool of unit is seized by spline of column .	-Check column assembly face and spline length (MAX 6.5㎜)
(3)Poor rotation of column	-Replenish oil or Exchange
2) Insufficient pump pressure or fluid volume	
(1)Check pump delivery (Unit volume×120 rpm×1.15)	-Exchange pump
(2)Check oil tank fluid volume	-Replenish oil
(3)Check pump pressure	-Adjust relief pressure
3)Trouble internal steering unit valve	
(1)Low setting pressure of relief valve	-Adjust fluid level properly
(2)Ball-nut heavy to work	-Wash clean or replace
4)Trouble machine mechanism.	
(1)Poor link work	-Wash and replenish oil
(2)Excessive sector gear pre-load	-Adjust backlash

2. Return to neutral is too slow

1)Poor assemble steering column and unit	
(1)Poor assemble to center between column and unit	-Loosen the bolt and fix again with center
(2)Column assembly face depressed unit bushing	-Replace column or repair
2)Depressed control set (spool+sleeve)	
(1)Excessive fluid volume	
(2)Excessive pressure	-Adjust fluid level properly
(3)Dust	-Adjust pressure
	-Wash
3) High pressure ratio of "T" port (tank port)	
(1) Tank port hall is small	-MAX. Pressure ratio 20 bar
(2) Tank port pipe is linked to other lines	-Wash and clean pipe line
	-Separate unit pipe line and reinstall

Problems and probable causes	Counter measures

3. Free play of steering wheel

1)Too low elastic of centering spring (Remove P port pipe line and check left and right turning) (1)Damaged spring or poor elastic	-Replace spring
2) Depressed control set (1) Excessive fluid and pressure (2) Depressed by foreign material (3) Depressed from external when assemble with column	 -Adjust fluid level and pressure properly -Wash -Check column and adjust

4. Steering wheel resistance with turning

(1)Worn of spline gear column	-Replace column
(2)Depressed control set	-Wash,and Adjust fluid level and pressure properly
(3)Air trapped in cylinder and pipe line	-Deflate the air
(4)Excessive backlash column	-Adjust column
(5)Poor turning of column,or wear of bearing .	-Replace column and replenish oil

5.Too much free play of steering wheel(Rough touching on tire causes vibration)

(1)Air trapped in steering cylinder and pipe line.	-Deflate the air
(2)Worn ball bearing	-Replace

6.Free play steering wheel

(1)Insufficient oil in the tank	-Replenish oil
(2)Worn,damage steering cylinder	-Replace oil seal and cylinder
(3)Loose spacer in unit	-assemble spacer parts.

7.Kick-back of steering wheel

(1)Loose check valve in "P" port or don't operate	-Adjust check valve
(2) Trouble in system	-consult workshop

Problems and probable causes	Counter measures

8.Serious kick-back each side

(1)Poor assemble the gyrotor lower the unit	-Reassemble

9. Steering wheel is very heavy to begin turning

(1)Oil density is too high or cool	-Replace oil

10. External Oil leakage

(1)column (2)End cap gyrotor (3)Tightening Bolt	-Replace oil seal,slide ring -Replace o-ring -Replace copper washer (Torque 1st:175 kgf·cm. 2nd:280 kgf·cm)

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Chapter 9 Hydraulic system

SECTION 1. GENERAL DESCRIPTION

The hydraulic system is composed of a gear pump,valves,oil filter,cylinder(actuator),piping,etc.The implement lift is operated by a control valve which is actuated by the control lever through a link mechanism.

ON and OFF of the PTO is controlled by a hydraulic,wet,multi-disc clutch whose circuit is opened and closed by an electromagnetic valve in the flow-divider.

The construction and circuit of the hydraulic system are shown in Fig.9-1 and 9-2

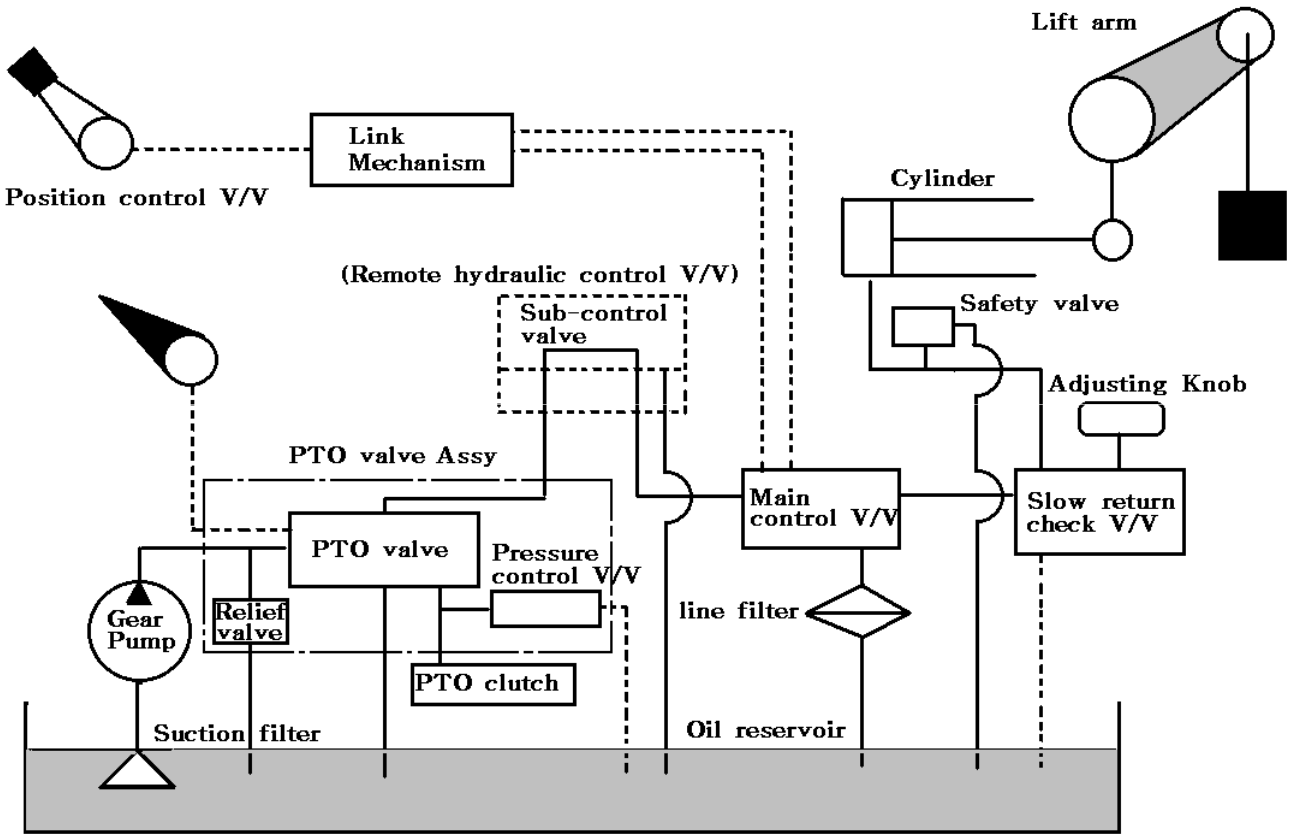


Fig.9-1 hydraulic system construction

SECTION 2.SPECIFICATIONS

		T303HST/T353HST
Piston and cylinder	Lift (kgf) (At lower link top end)	900
Control Valve	Cylinder port leaks (cc/min.) (Under a pressure of 9800kpa(100 kgf/㎠) With gear oil SAE 80W	10 (0.610 cu in)
Main relief valve	Cracking pressure (kgf/ ㎠)	120
	Relief pressure (kgf/㎠)	145
Gear Pump	Delivery(91% efficiency): litre (cu.in) mm at 2600rpm	21.5
	Fluid	TDH oil or Donax TD
Suction filter	Rated flow (ℓ/min)	35
	Filtration density (mesh)	150
	Filtration area (㎠)	450
Line filter	Rated flow (ℓ/min)	32
	Filtration density (mesh)	80
	Filtration area (㎠	31

NOTE: Recommendable Transmission oil

Manufacturer :Product

CALTEX :Textran TDH Premium

Texaco :TDH oil

Chevron :Chevron 1000THF

ESSO :Torque Fluid 56

MOBIL :Mobil fluid 423

SHELL :Donax TD

CASTROL :CASTROL AGRI MULTITRANS

TOTAL :Transmission MP

SECTION 3. MAJOR COMPONENT OF THE HYDRAULIC SYSTEM

1.HYDRAULIC SYSTEM

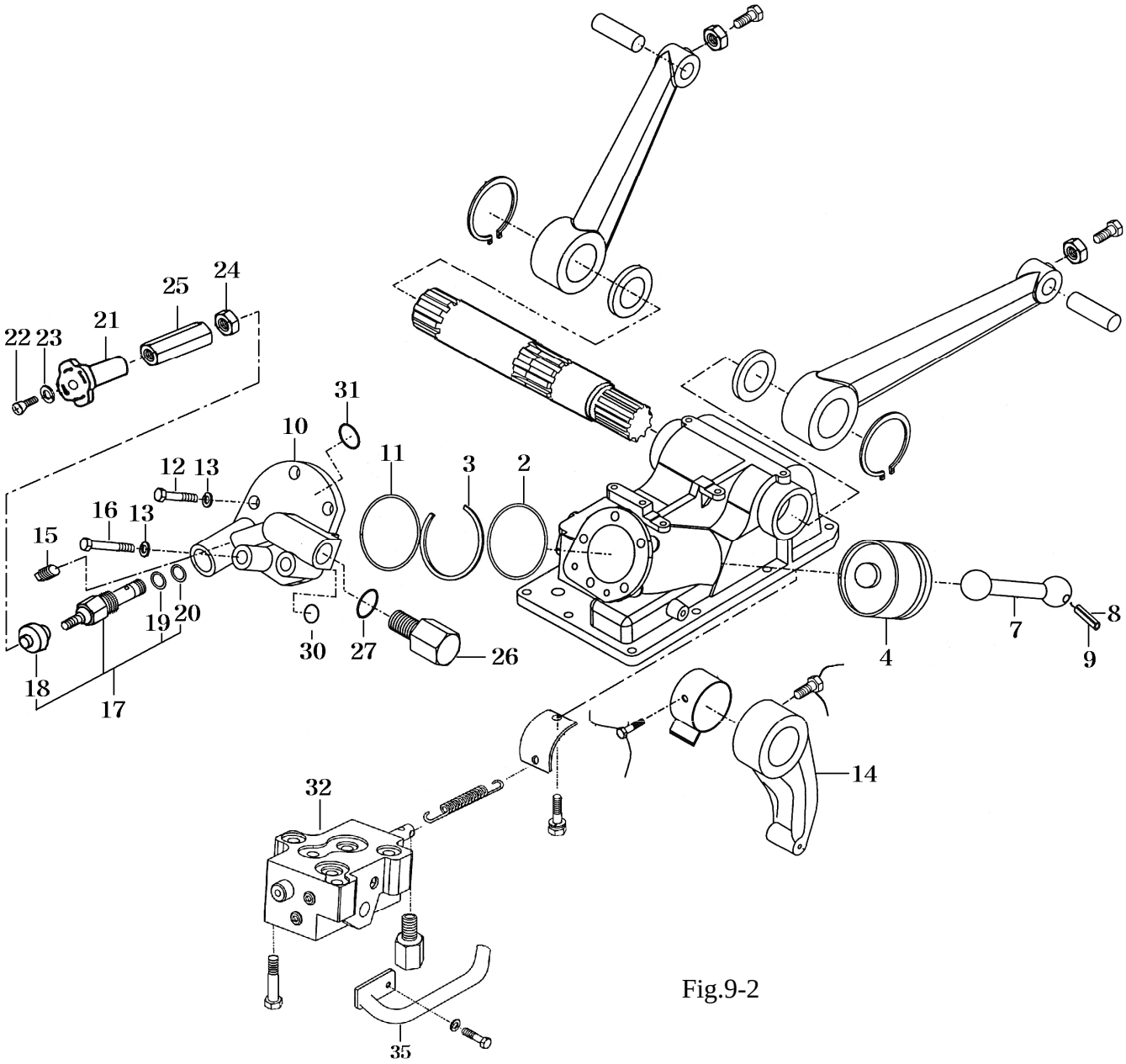


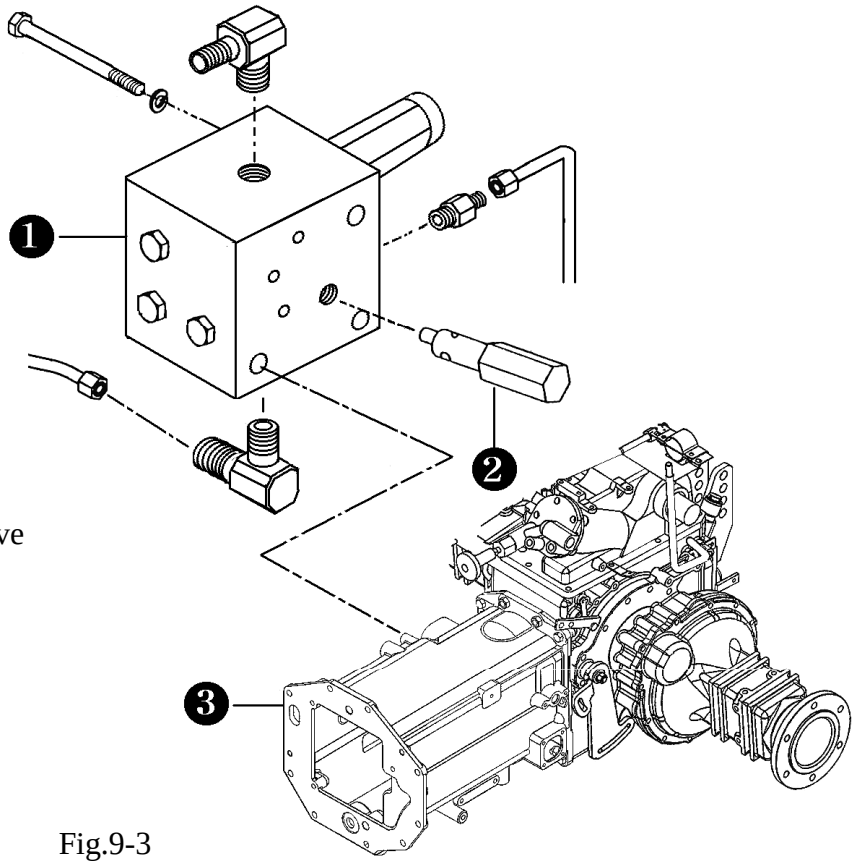
Fig.9-2

2.O-ring(PG6) 3.Ring-back up 4.Piston 7.Rod 8. Pin spring 9.Iron wire
10.Cylinder head 11.O-ring 12. Bolt 13.Washer spring 14.Lift crank
15.Plug 16.Bolt 17.Flow con.valve 18.Dust seal
19. O-ring(P) 20.O-ring(P) 21.Knob 22.screw 23.Washer spring
24.Nut 25.Shaft(Slow return) 26.Plug(M22) 27.O-ring(P)
30.O-ring(P) 31.O-ring(P) 32.Main control valve 35. Oil pipe

2.FLOW-DIVIDER

GENERAL DESCRIPTION

This valve is installed to bypass working fluid of a specified pressure from the main circuit into the PTO circuit through a fixed orifice.It includes a changeover valve for engaging and disengage the PTO clutch by means of a solenoid and a sequential valve for PTO circuit's over the main circuit.



(1) Flow-divider

(2) PTO pressure control valve

(3) Transmission case

Fig.9-3

(1)Solenoid

This solenoid is switched on or off by operating the PTO switch.With this lever operation,the solenoid shifts the changeover valve to the left or the right to bypass or block the flow to port B.

(2)PTO changeover valve

This valve is composed of the spool and spring.When the solenoid is switched on,the spool is moved to the left by overcoming the spring force and allows the fluid from the pump to flow from port P to port B through the fixed orifice.

-When the solenoid is switched 「ON」

The fluid from the pump flows to port B through port P,the pressure-reducing valve,and the changeover valve.

The pressure of the PTO clutch circuit and that of passage(2) are the same and will be set as P_2.The pressurized fluid acts on the left-hand side of the valve,passing through port ; its pressure will be set as P_1.

As passage (1) and passage (2) are interconnected,then $P_1=P_2$.

The force imposed upon the left-hand side of the valve is P1 whereas the force imposed upon the right side of the valve is P1 plus the spring force.Consequently the spool is pushed leftwards.

Here port A is blocked, so the fluid from the pump is branched off to the PTO clutch.

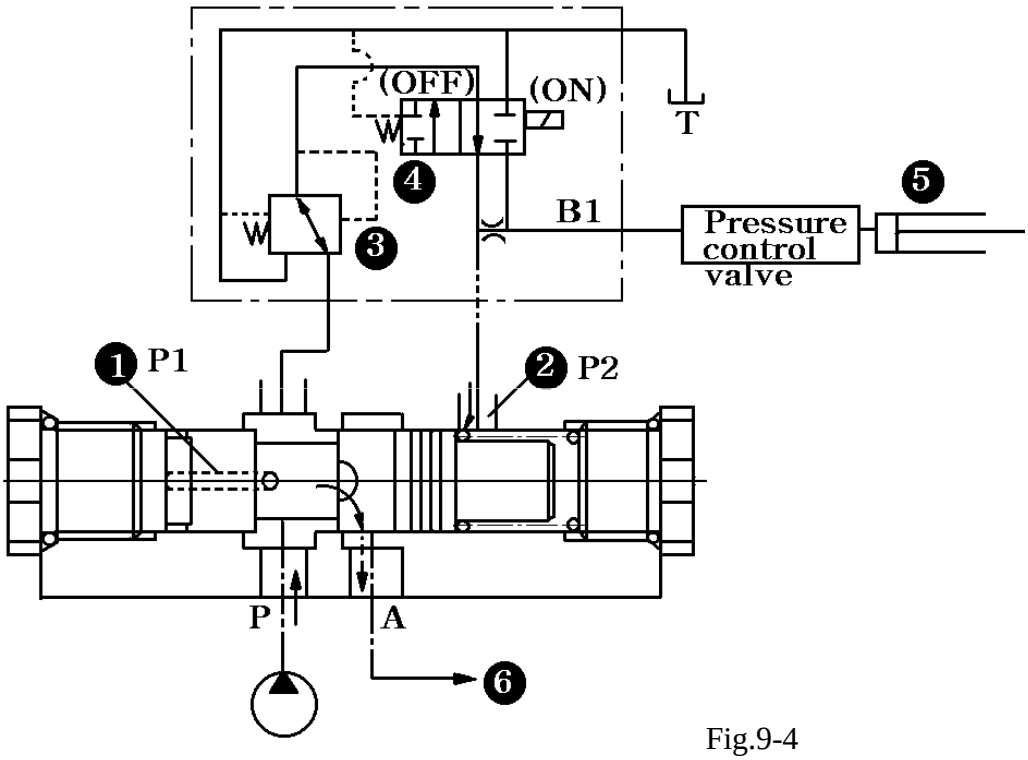


Fig.9-4

(1)Passage 1

(2)passage 2

(3)Pressure-reducing valve

(4)Changeover valve

(5)PTO clutch

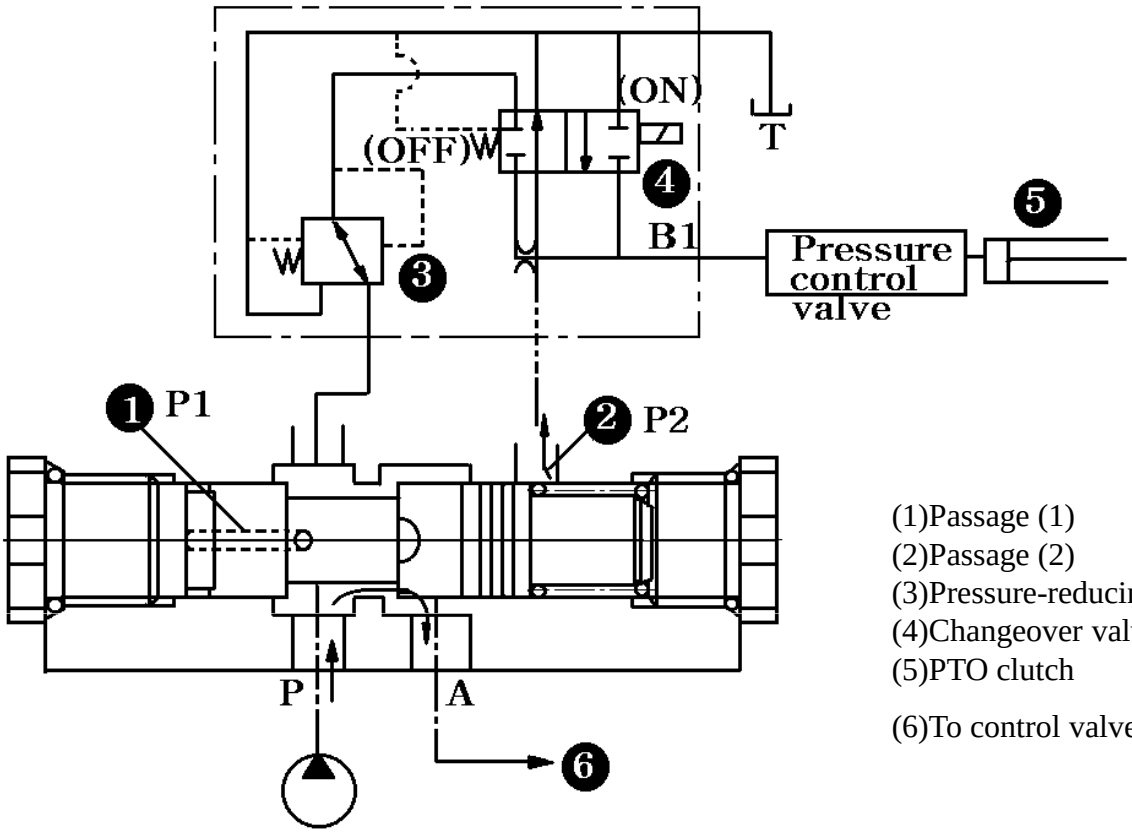
(6)To control valve.

-When the solenoid is switched 「OFF」:

The fluid in the PTO clutch is unloaded to the bank through port B.Consequently pressure P2

at passage(2) becomes zero,whereas the pressure at passage (1) is P1.Then the force imposed upon the left side of spool (P1)overcomes the force imposed upon the right side

(P2+spring force),so that the spool is pushed rightwards to connect port P and part A. Therefore no fluid from the pump is branched off to the PTO clutch; that is,all fluid flows to the control valve.



(1)Passage (1)
(2)Passage (2)
(3)Pressure-reducing valve
(4)Changeover valve
(5)PTO clutch
(6)To control valve

Fig. 9-5 PTO solenoid switch 「OFF」 position

(1) Pressure-reducing valve.

This valve is composed of the spool,spring,and piston and bleeds off the surplus fluid from the pump into the tank by actuating the spool when the fluid pressure exceeds the regulated pressure at port B

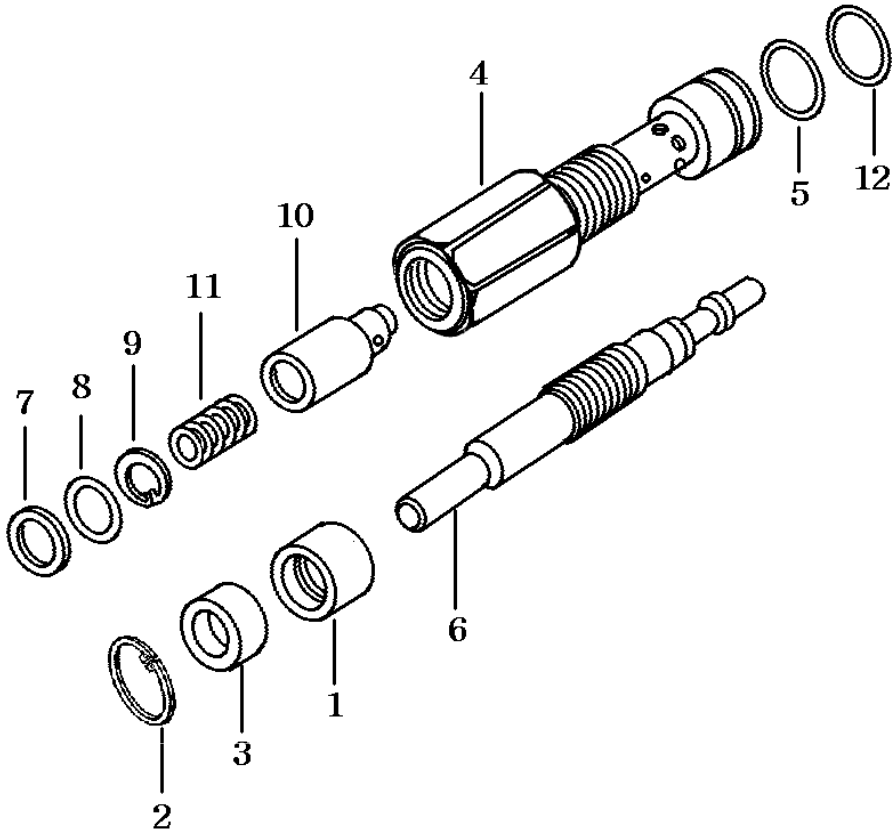
(2) Fixed orifice

This orifice controls the fluid flow at B in accordance with the pressure differential between the secondary pressure of the pressure reducing valve and the PTO clutch actuating pressure.

3.FLOW-CONTROL VALVE(SLOW-RETURN CHECK VALVE)

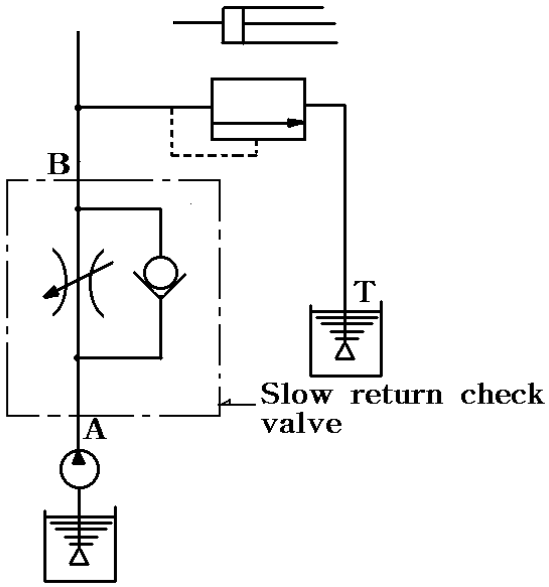
3.1. GENERAL DESCRIPTION

This valve regulates the lowering speed of the lift by controlling the unloading flow from the lift cylinder to the tank.



①Dust seal
②Snap ring
③Collar
④Body
⑤0-ring
⑥Adjust screw
⑦Back-up ring
⑧0-ring
⑨Stop ring
⑩Poppet
⑪Spring
⑫0-ring

Fig. 9-6 Slow-return check valve Diagram



3.2 OPERATIONS

1) DOWN position

The fluid from port B pushes up stop ring (9) of poppet(10) until the ring comes into contact with adjust screw(6),as it reaches chamber(R). Consequently,the extent choke (C) is opened is determined by the positioning of adjust screw (6):that is,when adjust screw(6) is screwed in clockwise,the opening of chock(C) decreases and the lowering speed of the lift arm slows down;whereas the opening of choke(C) increases and the lowering speed of the lift is accelerated when the adjust screw is unscrewed counterclockwise.When the adjust screw screwed in completely,the poppet comes into contact with body seat(S) and the choke is closed completely,so the lift arm stops.

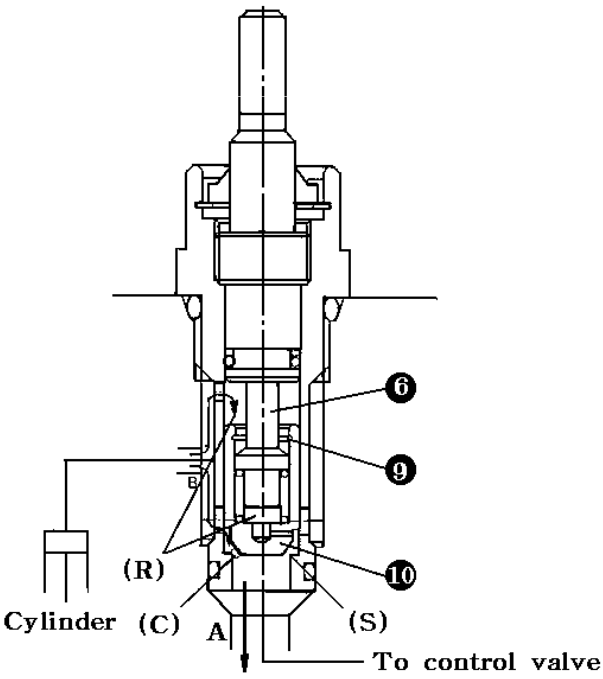


Fig. 9-7 Down position

2) Up position

The flow port A,overcoming the force of spring(11),pushes up poppet (10) and choke(C)is fully opened regardless of the position of adjust screw(6).Thus the fluid flows to port B and the cylinder,which results in raising the lift arm.

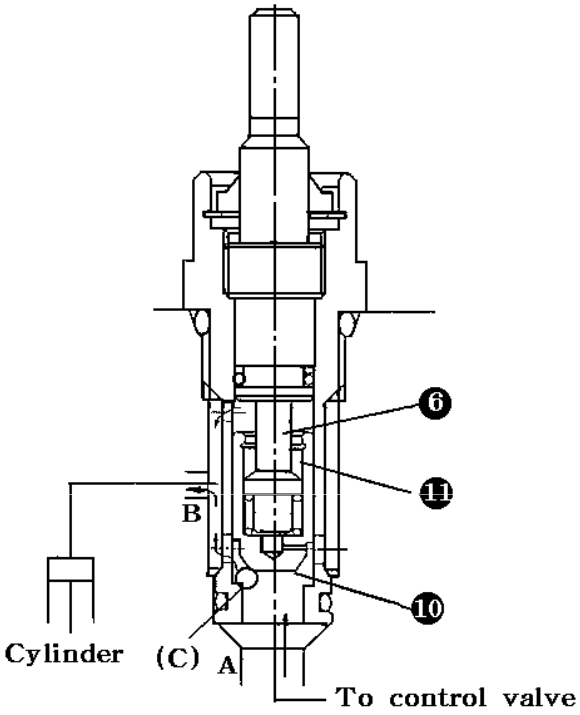


Fig. 9-8 Up position

4. RELIEF VALVE

1)GENERAL DESCRIPTION

This valve regulates the maximum pressure in the whole hydraulic circuit.The regulated pressure can be set with the adjust screw.

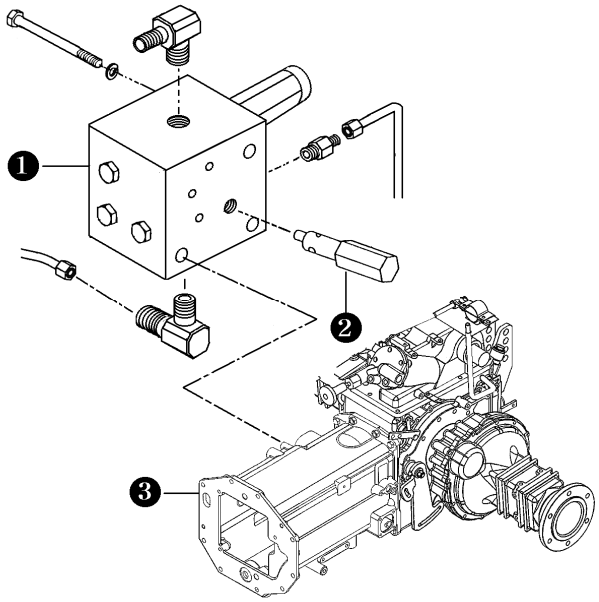


Fig. 9-9 Relief valve in PTO solenoid V/V

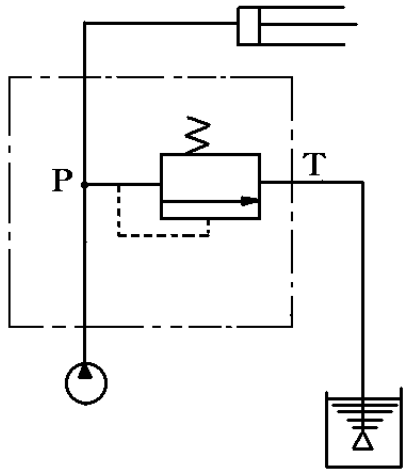


Fig 9-10 relief valve circuit.

2) PRECAUTIONS FOR DISASSEMBLY AND REASSEMBLY

(1)Tightening torque of lock nut (9)5.0~6.0 ㎏f·㎝(36.2~43.4 ft.lbs)

(2)Install seat(2)and then tap ball(3)(5/16) lightly so as to provide tight seating.

(3)Wrap the valve threads with sealing tape and tighten the valve up to a specified torque of 5-6Kgf.m(36-43 ft.lbs)

(4)Before disassembly, the current screwing-in depth of the adjust screw should be written down or memorized for later reference.

3) MEASUREMENT OF THE RELIEF PRESSURE

(1)3 POINT TO TEST RELIEF PRESSURE

①Remove the plug in the delivery pipe on the right-hand side of the transmission case and install a compression gauge to measure the pressure.

Keep the engine speed at 2600 rpm and shift the position control lever at the highest position.

②Control valve coupler.

③Remove the plug in the hyd. pump flange and engage the pressure gauge and measure it.

Measurement the Pressure must be done 3 times and should be set within specified pressure.

Specified relief pressure	145 ±5 ㎏f·㎝

5.GEAR PUMP

1) GENERAL DESCRIPTION

This pump induces fluid from one side and delivers it from the other side,by rotating two gears meshed with each other. The actual delivery is as mentioned below,considering the consequences of fluid temperature and volume efficiency in accordance with revolution speed. That is dual pump system.

2) Gear pump

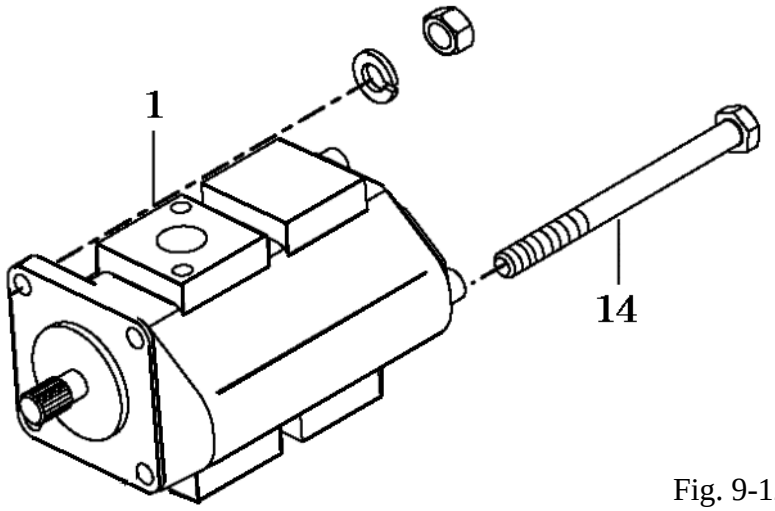


Fig. 9-12 Gear pump

3) OPERATIONS.

This pump induces fluid from one side and delivers it from the other side,by rotating two gears meshed with each other.
The actual delivery is as mentioned Fig.9-13, Considering the consequences of fluid Temperature and volume efficiency in accordance with revolution speed.

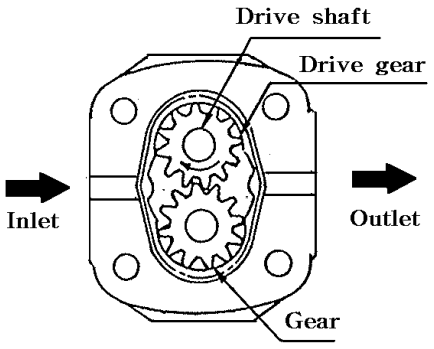


Fig. 9-13 Gear pump

4)DISASSEMBLY

NOTE:

①Before disassembling the pump,wash the outside clean.In the course of disassembling operation,all disassembled parts should be kept aside in a clean place such as on clean paper or cloth and be handled carefully so as to prevent them from becoming dirty or damaged.

Check all disassembled parts for damage and wash undamaged or usable parts in clean diesel fuel or kerosene. Inspect all parts referring to these point,and repair or replace defective parts.

(1)DISASSEMBLY

①Remove the key.

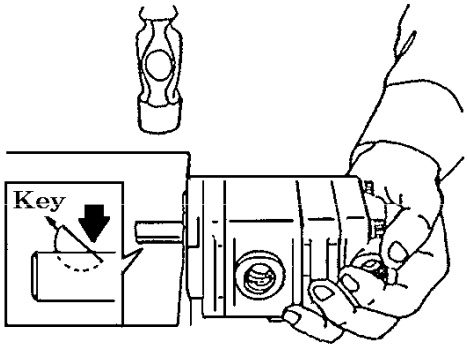


Fig. 9-14 Drive shaft key.

②Hold the pump in a vice with the mounting flange turned downward,and remove the bolts

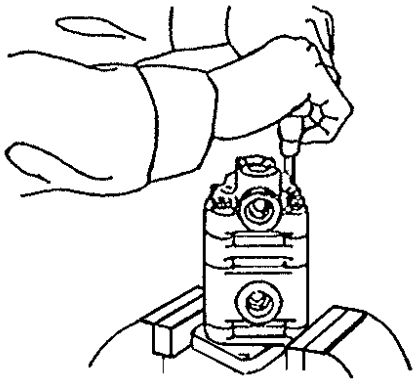


Fig. 9-15 Cover bolt

③Remove front and rear pump.
Be sure not to be damaged the o-ring or steel ball

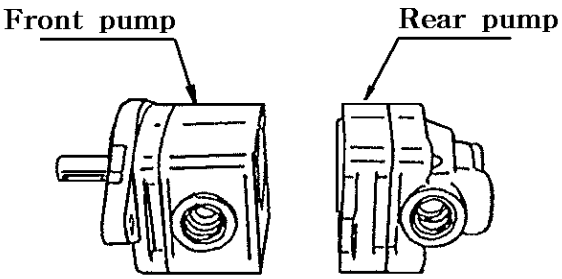


Fig. 9-16 Front and rear pump

④Remove the rear pump
▶Detach the cover
▶Remove the o-ring
▶Remove the bushing,drive gear,gear and bushing.Take care of removing the bushing which is marked and recorded.
▶Remove the bushing seal from the bushing.

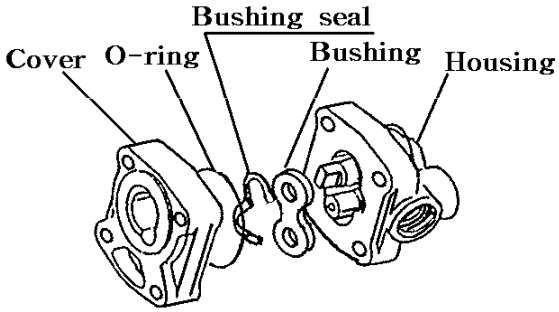


Fig. 9-17 Front and rear pump

⑤Remove the front pump same as rear pump disassembly.
⑥Remove the snap ring and extract oil seal from the flange.

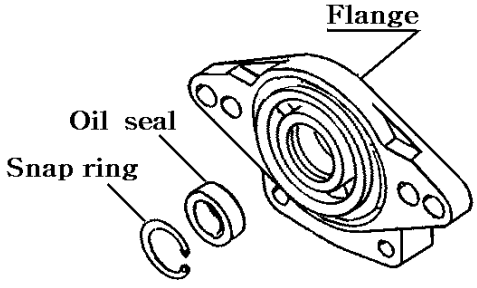


Fig. 9-18 Front and rear pump

3) REASSEMBLY

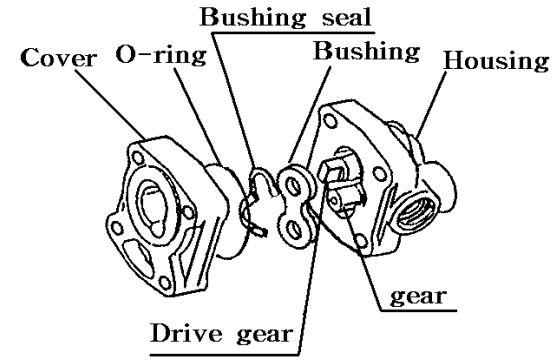
① Install the rear pump.

▶Install the bushing seal to bushing.

▶Install the bushing,drive gear,gear,and bushing to the housing.

▶Install the o-ring to the cover.

▶Install the cover to the housing.



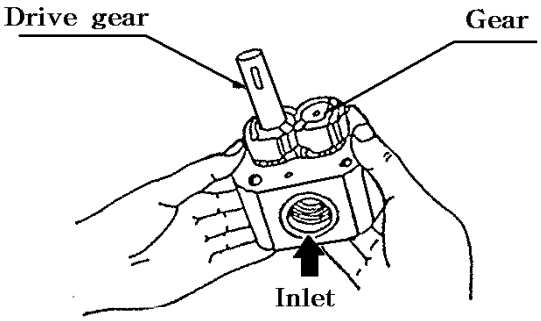


Fig. 9-19 Front and rear pump.

②Install the front pump with rear pump.

③After installing the cap ring,and O-ring to the front pump,and install the rear pump.

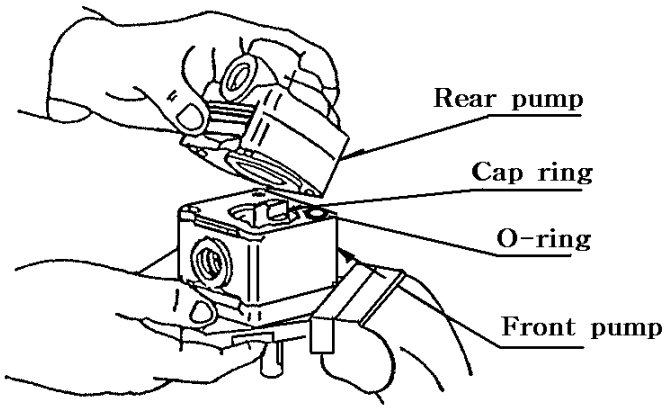


Fig. 9-20 Drive gear,gear,Gasket

④Tightening sequence and torque of the pump cover tightening bolts.

▶Tightening torque: 2.5~2.8㎏f·m

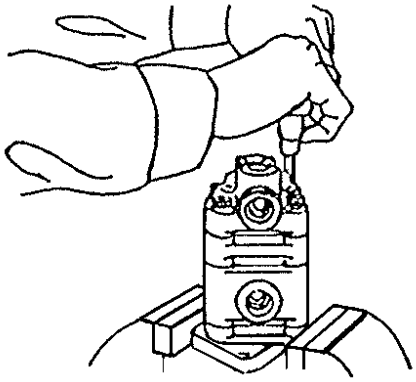


Fig. 9-21 Cover bolt

⑤ Install the oil seal,snap ring,and key.

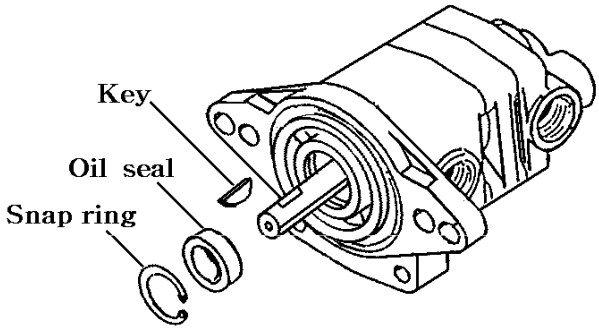


Fig. 9-22 Oil seal,snap ring,key.

⑥The gears should turn smoothly with a turning torque of less than 30 kgf.cm (2.2ft.lbs)

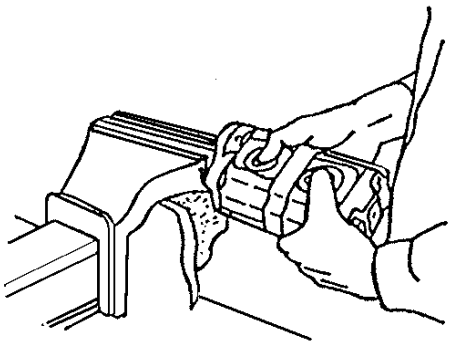


Fig. 9-23 Inspection after reassembly.

4) INSPECTION AND REPAIR

(1)Check all disassembled parts for damage and wash undamaged or usable parts in clean diesel fuel or kerosene except rubber parts.Inspect all parts referring to these points,and repair or replace defective parts.

(2) Housing(casing)

①The gear pump is originally designed so that the gears come into light contact with the side of the pump body

②Therefore some evidence of contact can be found around the intake port of a pump once used.

③The normal contact tracing is less than half the length of the gear housing bore and less than 0.05 mm(0.0020 in)in width.If width A is more than 0.1 mm(0.004 in), replace the gear pump set.

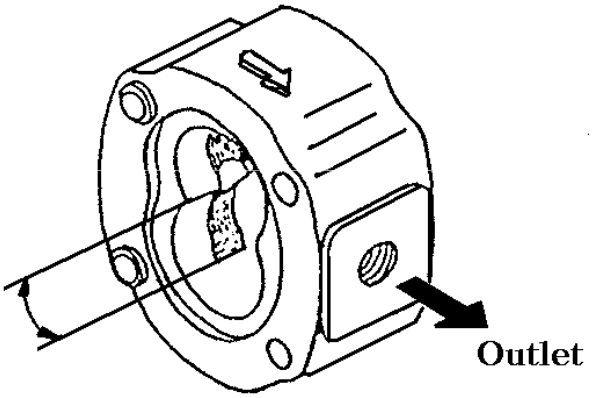


Fig. 9-24 Housing (casing)

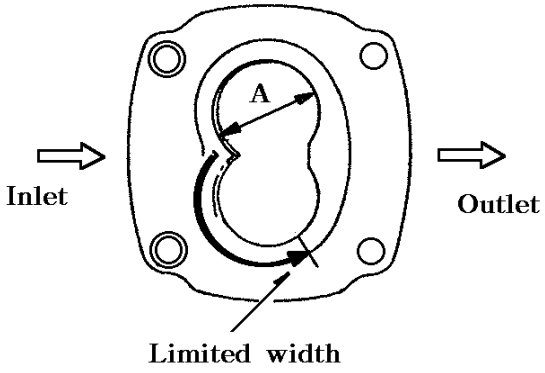


Fig. 9-25 Housing (casing)

(3) Bushing

① With clean working fluid,surfaces are rarely scratched and should be smooth.

② If there are many scratches on the bore walls,or on parts which are in contact with the gears,which can be readily felt or when the latter parts are darkened,the gear pump set should be replaced.

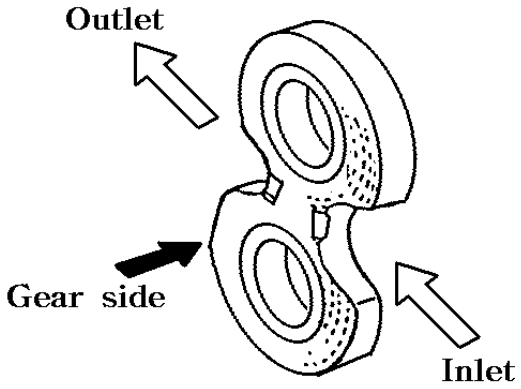


Fig. 9-26 Bushing

Problem and causes are as below

a.contaminated fluid

b.overload by relief valve damage

c.cavitation or airation

d.overheat of fluid.

e.Low density of fluid

④ Some evidence of contact can be found around the intake port of a bushing once used.The normal contact tracing is less than half the length of the bushing bore and less than 0.03mm(0,0012 in)in width.If width is more than o.o3 mm (0.0012 in).Replace the bushing.

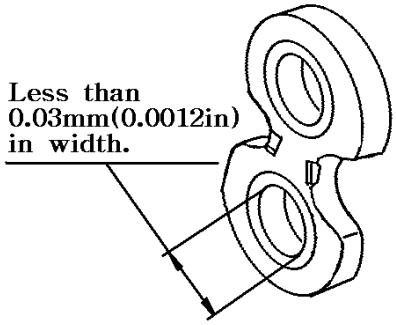


Fig. 9-27 Bushing

(4) GEAR

①With clean working fluid,surfaces are rarely scratched and should be smooth.

②If roughness can be felt by a finger nail,they are darkened,or the shaft diameter is less than 0.03 mm replace the shaft.

③Usable shaft diameter is as below

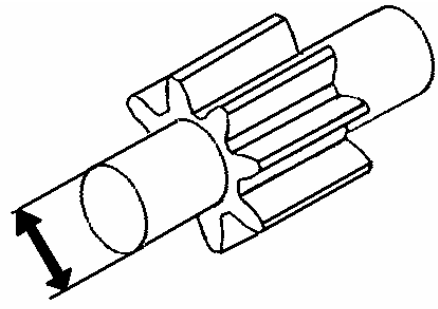


Fig.9-28 gear shaft

(5) Oil seal

The oil seal prevents oil leaks by its inner seal lip and dust from invading by its outer dust lip.Therefore if an oil seal has damaged or deformed lips,it should be replaced.

(6)MEASUREMENT OF THE PUMP

The best way to measure for the pump is to use a special tester.

But if it's not available,Use installed tractor

Remove the plug in the delivery pipe on the right-hand side of the transmission case and install a compression gauge to measure the pressure.

Keep the engine speed at 2600 rpm and shift the position control lever at the highest position.

6. FILTER

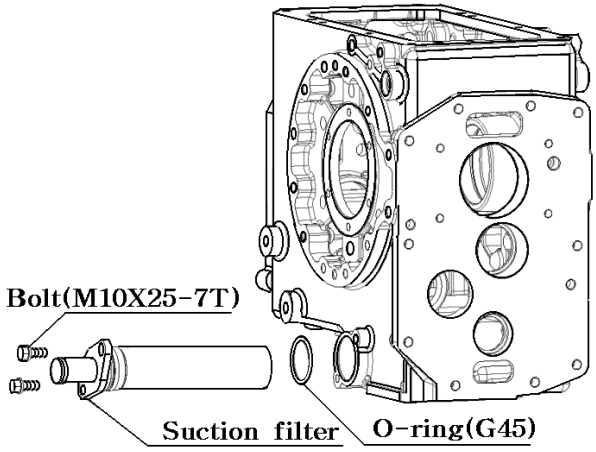


Fig. 9-30 Filter

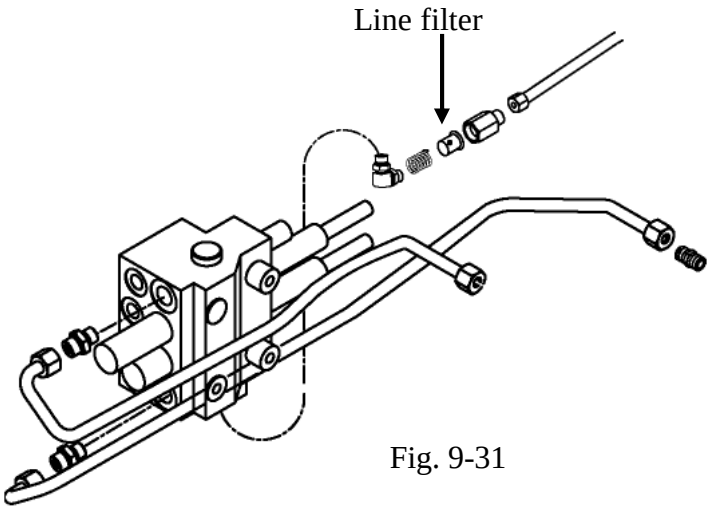


Fig. 9-31

1)GENERAL DESCRIPTION

The tractor is equipped with two oil filters: suction filter(1) and line filter(4),for better filtration.

2) SPECIFICATIONS

-Suction filter

Applicable oil	DONAX TD or RPM THF 500
Rated flow rate(ℓ/min.)	35
Filtration density (mesh)	150 mesh
Filtration area	450 ㎠
Working oil temperature (℃)	-30 ~130℃

3) Line filter

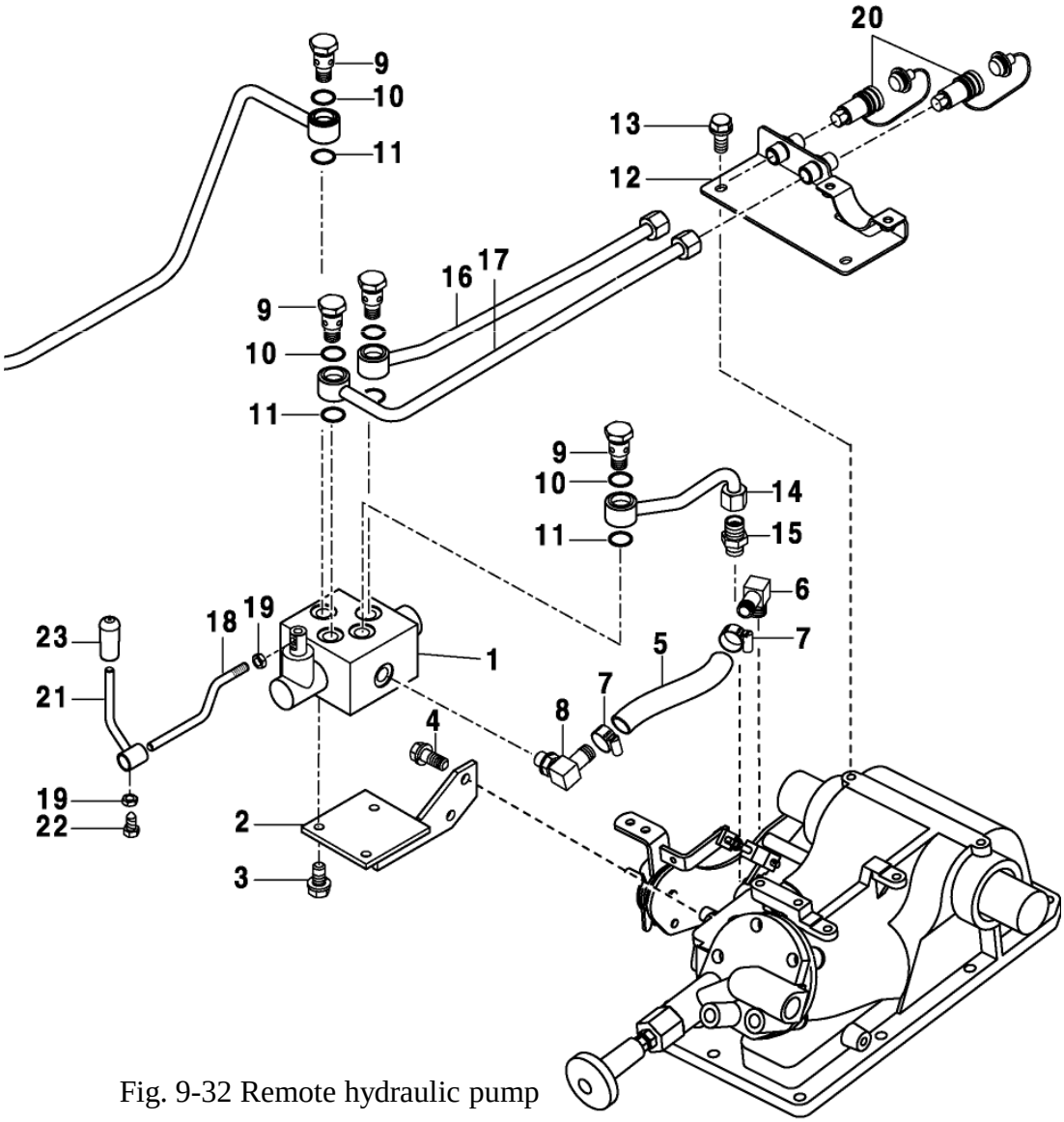
Applicable oil	DONAX TD or RPM THF 500
Filtration density (mesh)	80 mesh

4) REPLACEMENT

Check the O-rings for damage or deformation and replace defective ones.When installing the filters,be sure to install the O-rings properly with grease applied.

Maximum flow (ℓ/min)	26
Maximum pressure(bar)	25
Viscosity range	12 to 400 ㎟/s
Temperature range of the fluid	-20 : BC to +80:BC
Environmental temperature	-40: BC to +60:BC
Max. level of contamination of the fluid	19116 ISO4406
Internal leakage	3㎤/min at 100 bar 40: BC and 46 ㎟/s

1.Remote hydraulic control valve(OPTIONAL)



1.Remote Valve
2.Stay
3.Bolt
4.Bolt
5.Hose return
6.Adapter PF/90
7.Band
8.Adapter 9/16-UNF90
9.connector
10.O-ring
11.O-ring
12.Stay
13.Bolt
14.Pipe
15.Union
16.Pipe
17.Pipe
18.Lever
19.nut
20.Coupling
21.Lever
22.Bolt
23.Grip

Fig. 9-32 Remote hydraulic pump

SECTION 5. HYDRAULIC SYSTEM

1.HYDRAULIC CYLINDER

1) Hydraulic system must be washed clean,and care must be taken not to let any foreign substances.
2) The O-ring and back-up ring should be coated with grease ahead of time.Install with care so as not to damage them.
3) Install the Piston from the cylinder head side.
4) The lift arms should be assembled mutually by reference to their matching marks.
5) When installing the control valve,apply grease to the O-rings and avoid their dislocation or binding during tightening the valve to the specified torque 130 ~180㎏f-㎝
6) The safety valve should be installed levelly,and make sure there is no oil leak through the filter seal . Tightening torque is 700~800 ㎏f-㎝
7) The spool should move smoothly after assemble the control valve.
8) The lift crank should be installed levelly,and make sure there is no interference through the pipe.

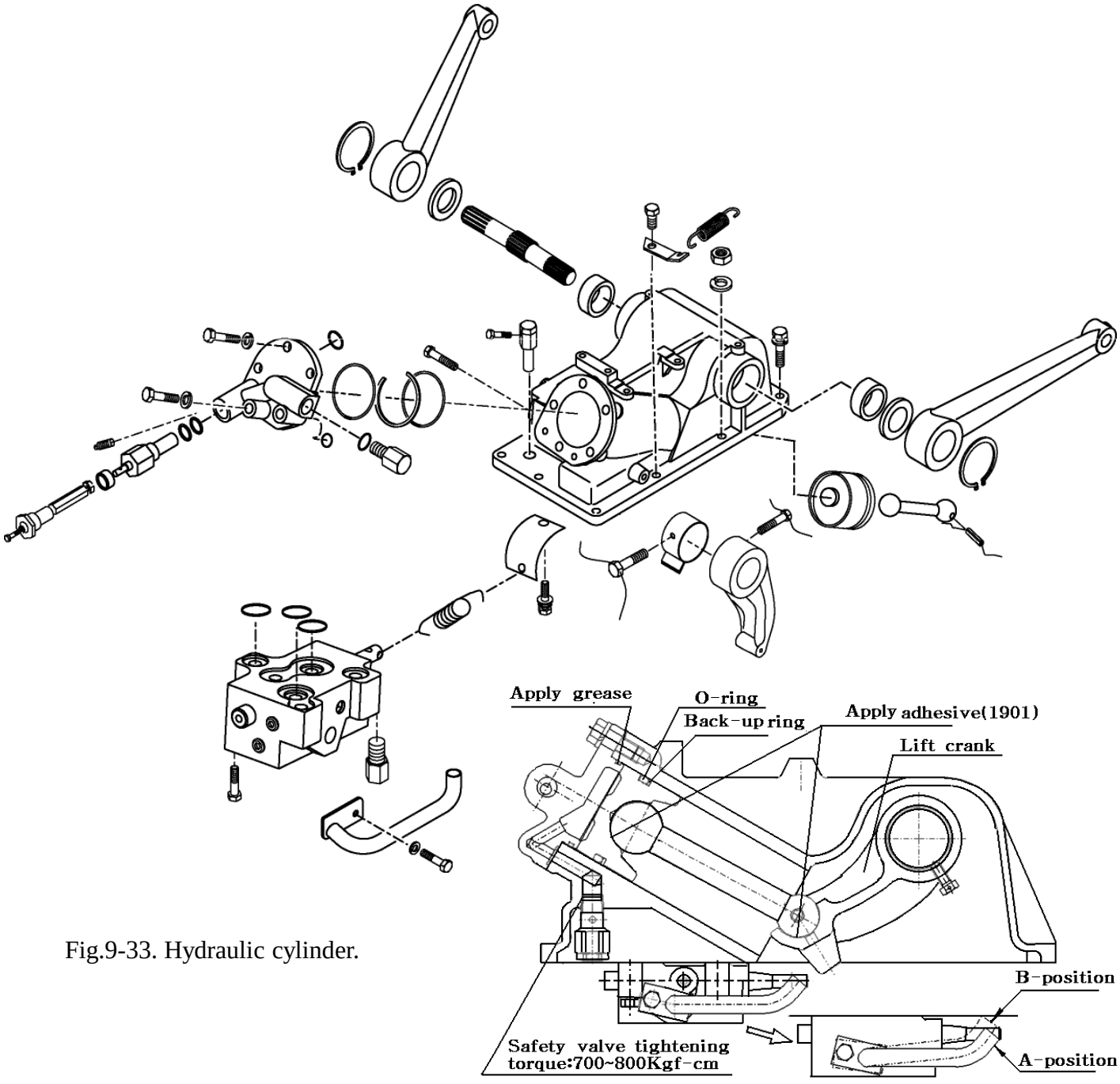


Fig.9-33. Hydraulic cylinder.

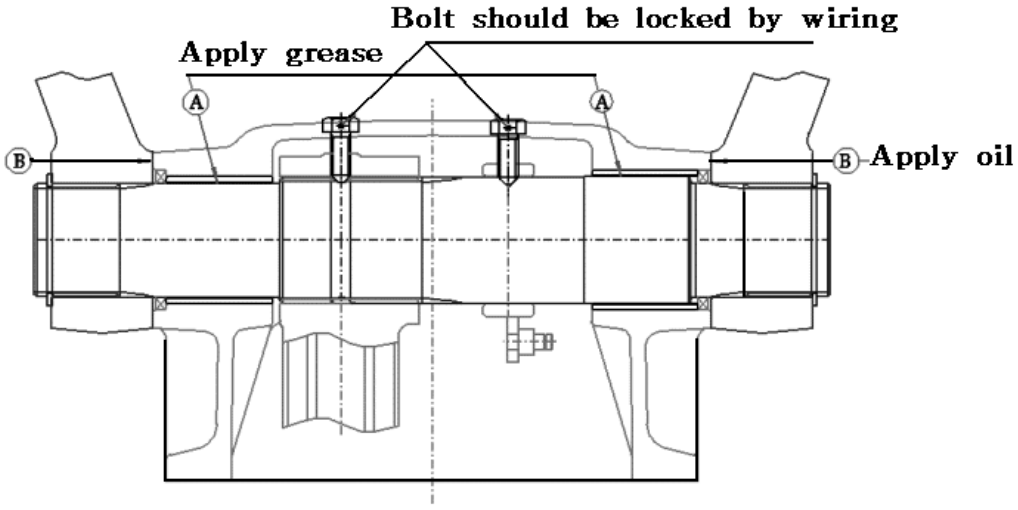


Fig.9-34.Lift arm

9) Adjust the angle of the roll bush from horizontal is 30°
10) Apply grease to the roll bush.
11) Apply grease to the cylinder case and lift arm face Which touched with each other.
12) When assemble the lift crank on the lift shaft, mesh their splines using the alignment marks which were put there before disassembly.
13) Hex bolt (M8×20) should be locked by wiring after installation .
14) Be sure the lift shaft should be moved smoothly after installation.
15) The clearance of lift arm should be less than 3 mm

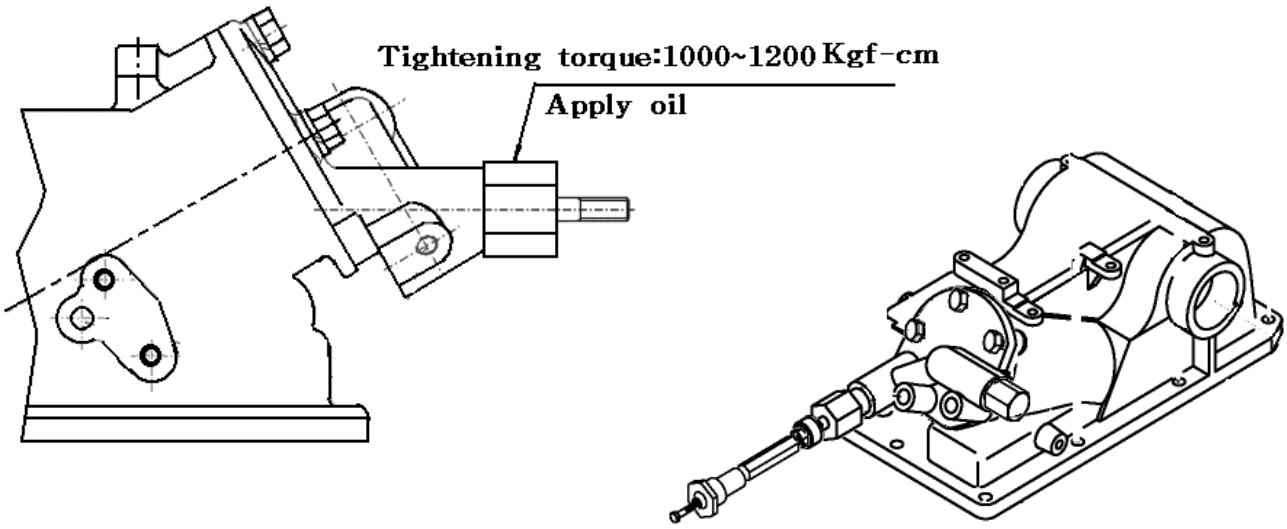


Fig. 9-35 Slow return check valve.

16)Rap the plug with sealing tape.
17)Tighten the slow return valve to the specified torque 1000~1200 kgf-cm and be sure not to damage the O-ring.

2. LINKAGE (INTERNAL)

1)Before installing the linkage,apply grease to relayed drive parts.

2)Drive in the roll pin into the linkage pin through the rod and lock the pin with wire.

3)Be sure not to over operate within specified spool stroke(12mm between up and down at neutral position)

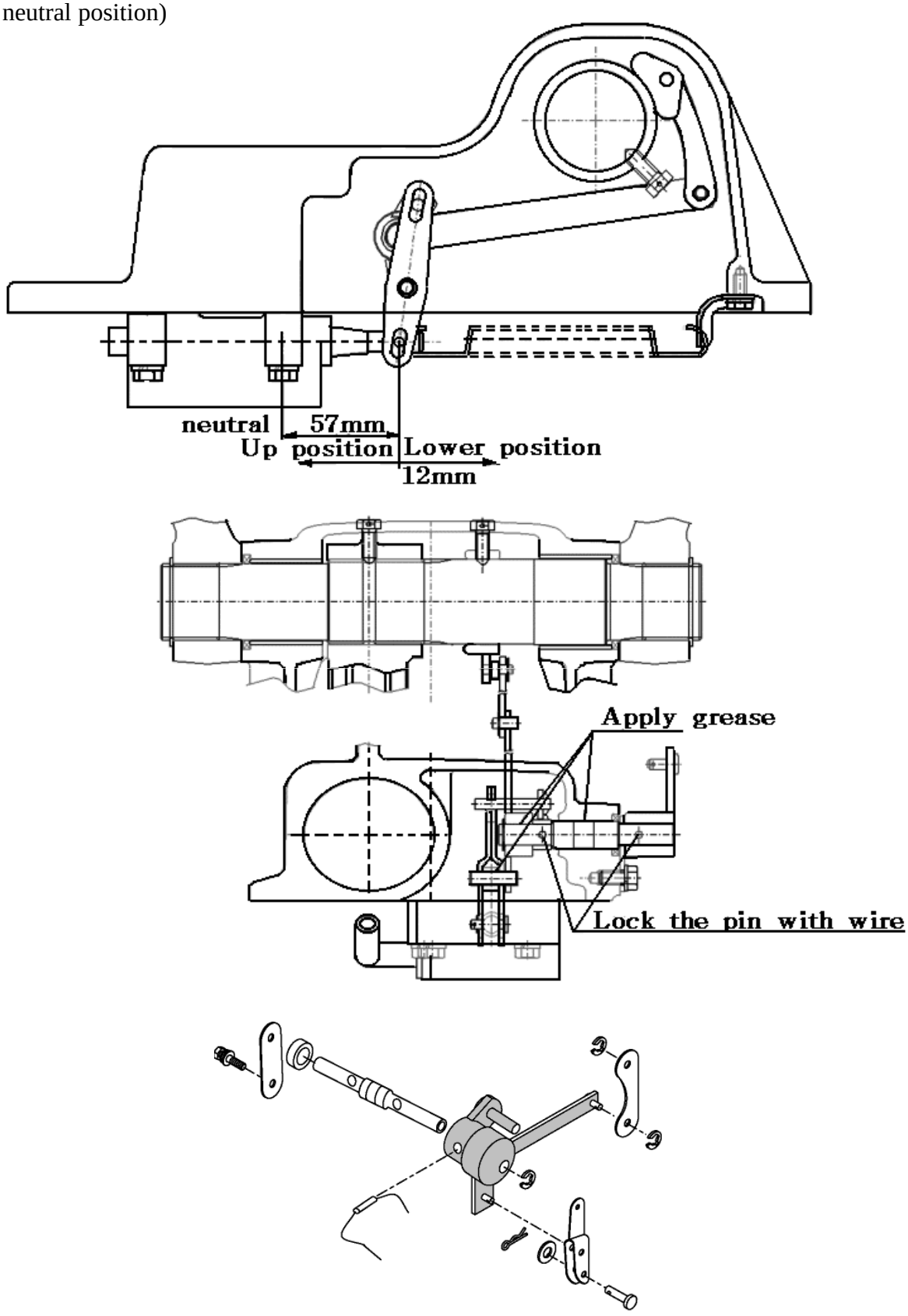


Fig.9-36 Linkage (internal)

3.LINKAGE (EXTERNAL)

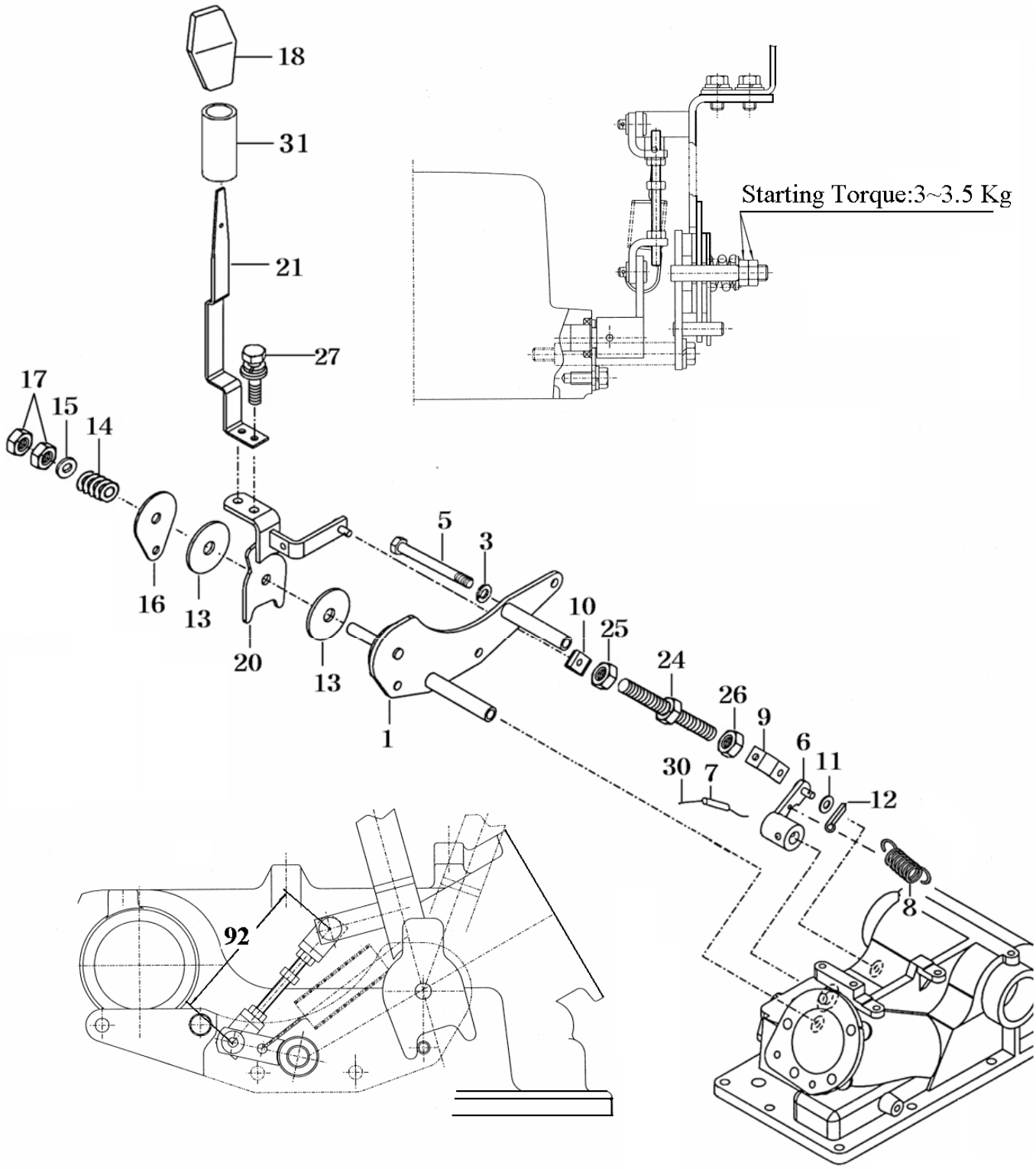


Fig. 9-37 Linkage(external)

4. MAIN CONTROL VALVE

4.1 GENERAL DESCRIPTION

This valve controls the lifting and lowering operation of the hydraulic cylinder.It has especially been developed to control the working height of the implement.It consists of a feed back valve;direction control valve,flow-control unloading valve,and holding check valve.

4.2 SPECIFICATIONS

Maximum operating pressure	300 Kgf.cm(4267 psi)
Maximum flow	30 liters (1831 cu.in)/min
C-port leaks	10 milliliters (0.61 cu.in)/min (Fluid temp : 50℃:pressure :100Kgf.cm(1422 psi)

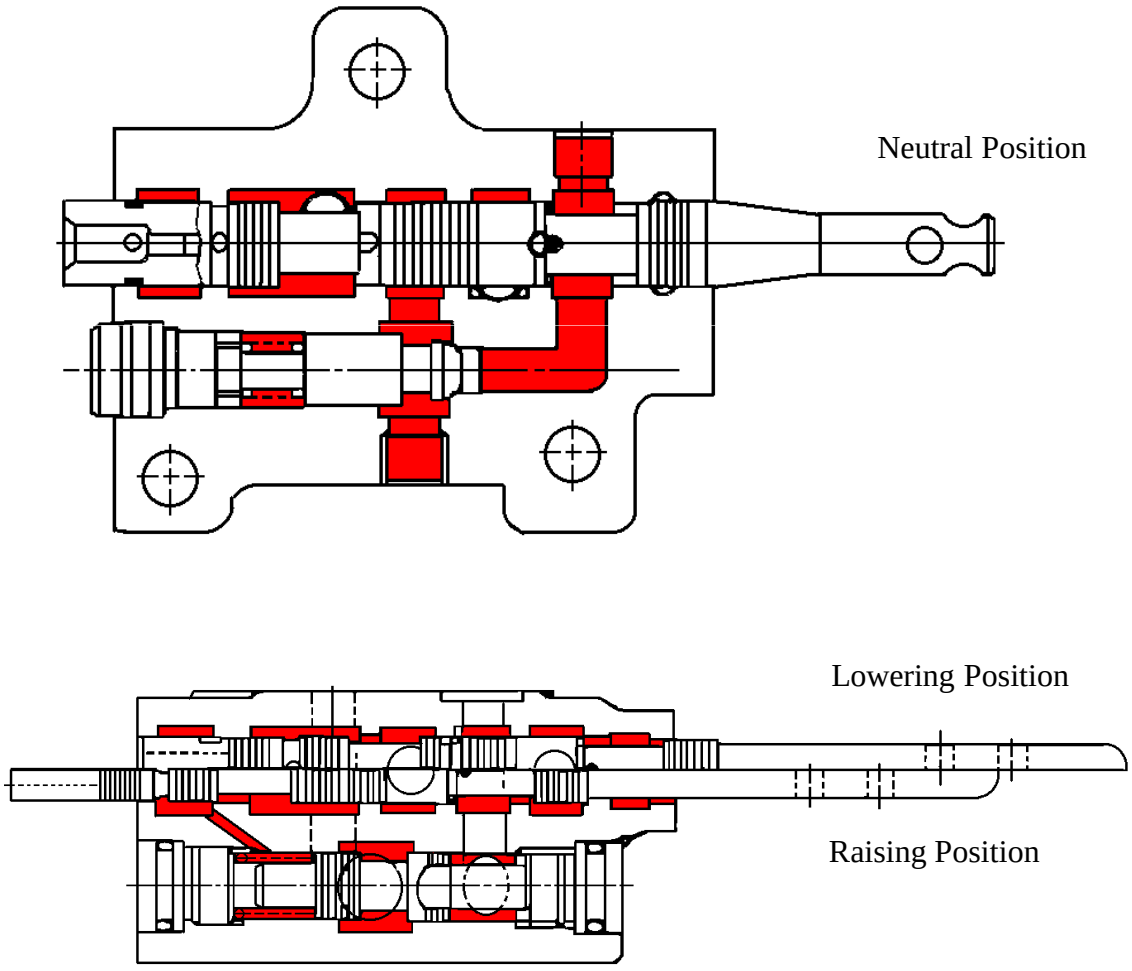
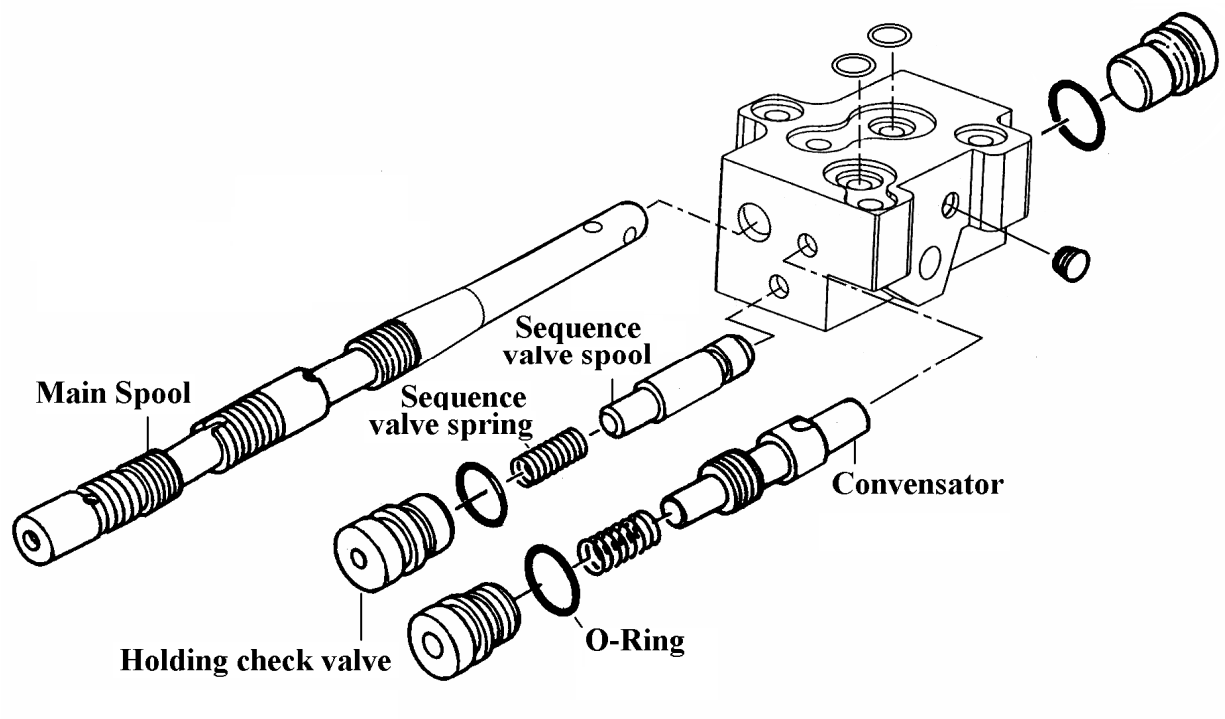


Fig.9-38

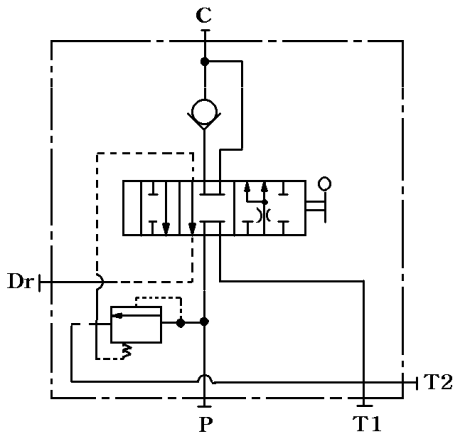
4.3 DISASSEMBLY AND INSPECTION



4.4 OPERATION

1) Neutral position

In the neutral position,convensater spool(711) in open (Unload), Main spool(311) and check valve(511,531) is closed and its pressure is enough to rest the force of lift arm..



Circuit diagram in the neutral position

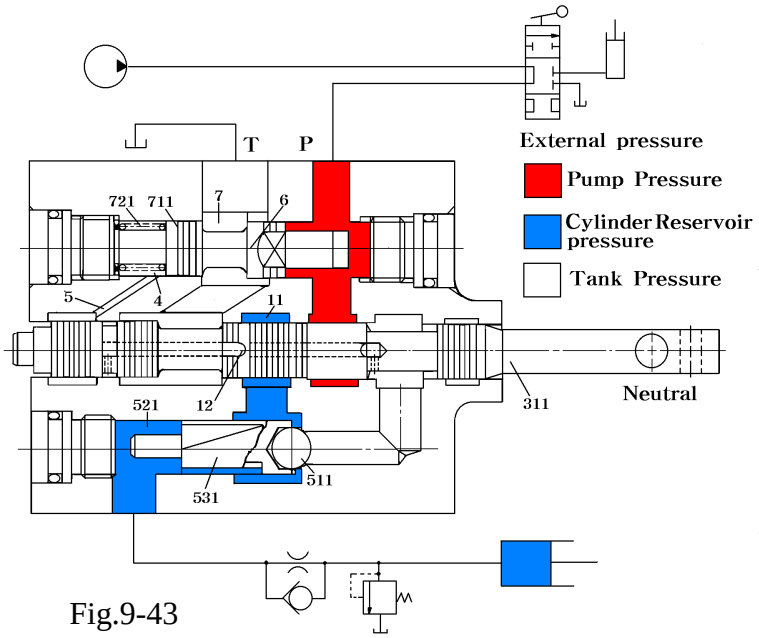
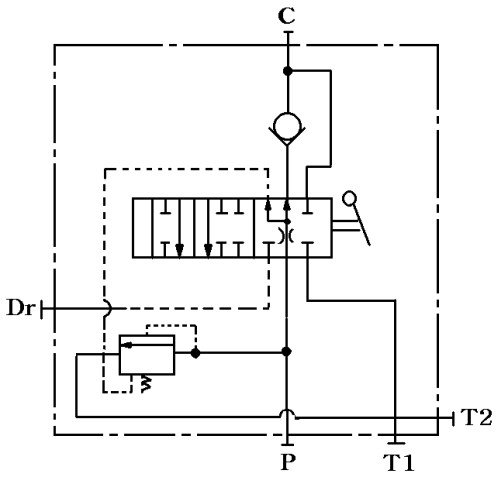


Fig.9-43

2) Lifting position

As main spool is moved to lifting position pump pressure is increased and open the check valve(511,531). The lift arm moved to lifting position by flowing to cylinder and operate piston.



Circuit diagram in the lifting position

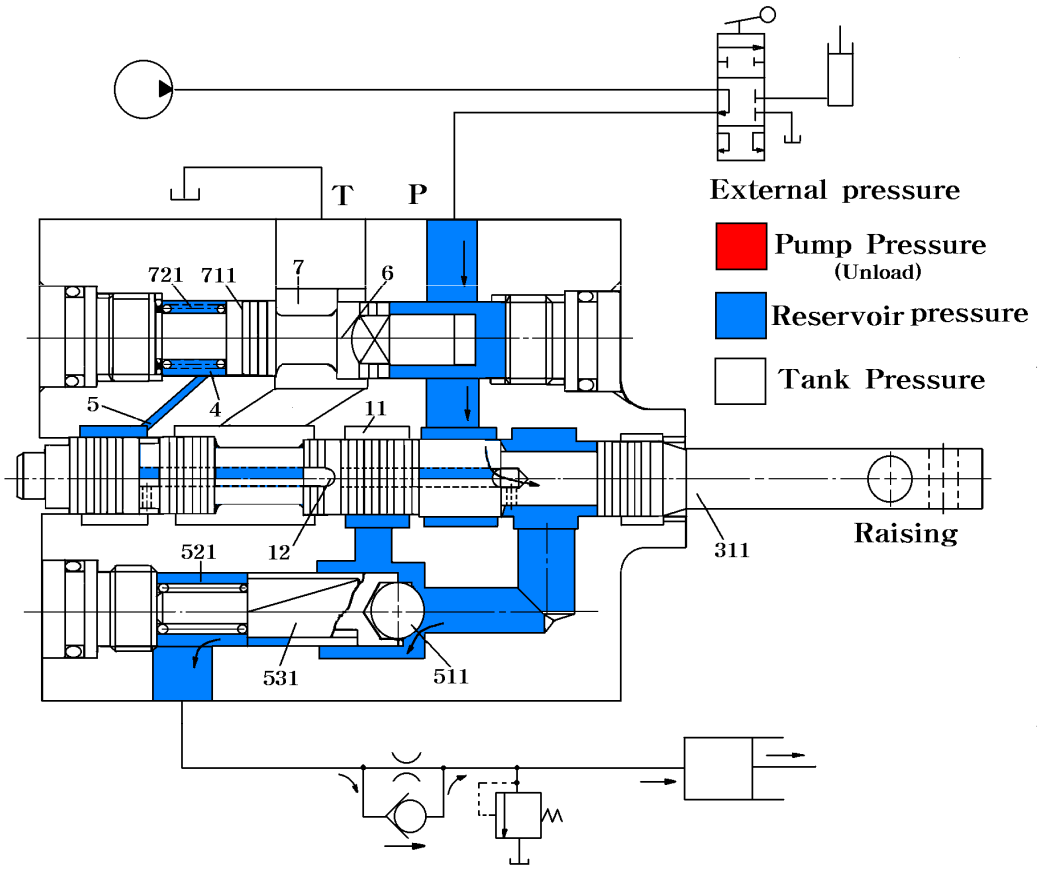


Fig.9-44

2) Lowering position

If main spool moved to lower positions,pump is unloading and the lift arm moved to lower position by flowing to tank in the cylinder

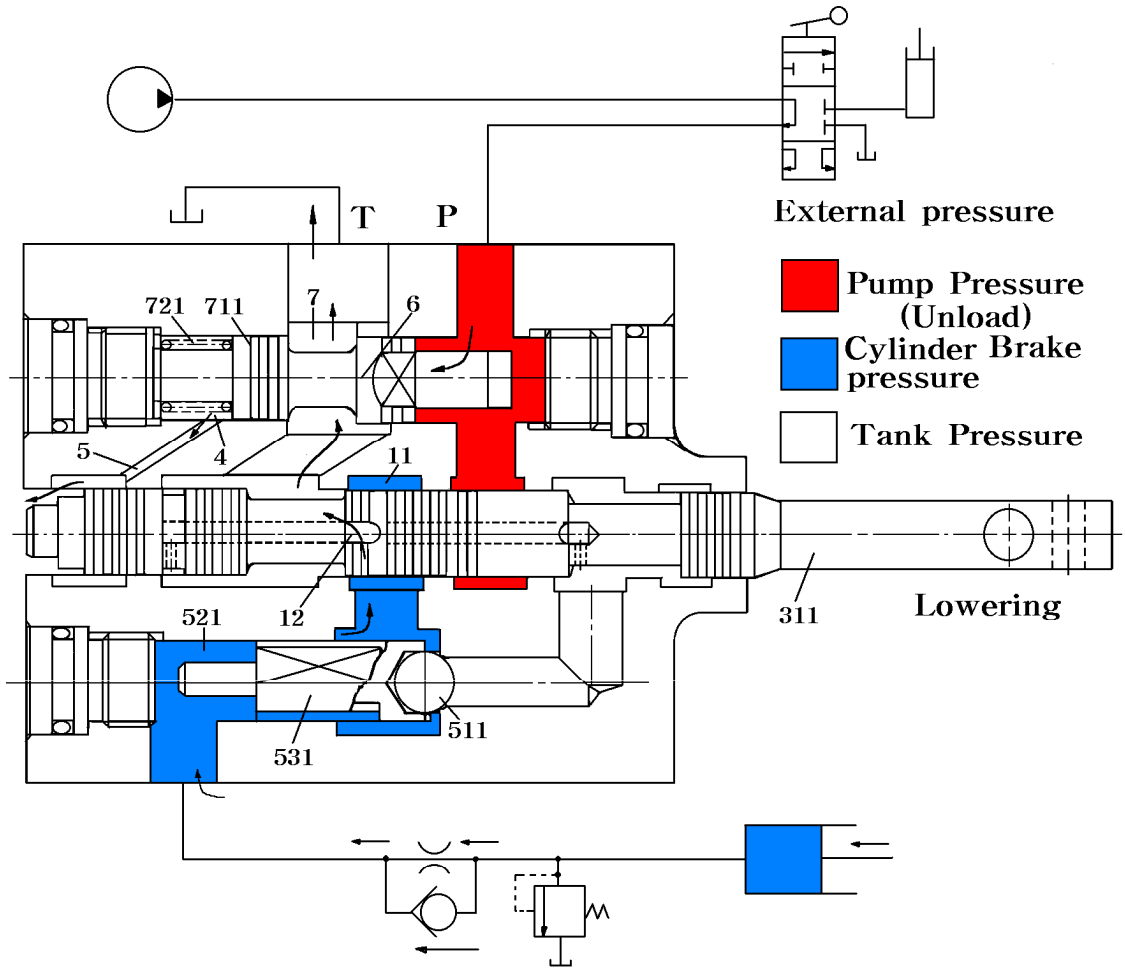


Fig.9-45

5. SERVICING INSTRUCTIONS.

1) Required tools
-6mm set screw wrench and torque Wrench
-19mm spanner and torque wrench
-22mm spanner and screw wrench
-conventional screw driver[3mm(0.12 in) in blade width]
-plastic rod [Ø10mm(Ø0.394 in)]
Oil stone,cleanser,tweezers,etc.

2) Tightening torque

Description	Size	Tightening torque Kgf.m(ft.lbs)
Plug	M16	3.5 (25.3)
Plug	M14	2.5 (18.1)
Sunk Plug	PT /4	2.5 (18.1)
Spool head	M6	0.8 (5.8)
Stopper bolt	M6	0.8 (5.8)

3) Disassembly

-Main spool and related parts.

Remove the snap ring E and draw out the main spool carefully.

Note:
The main spool and spool head are screw-fitted, so they can be separated from each other.But they are tightened with adhesive applied,so they should not be disassembled unless required.

-Holding check valve and related parts.
Remove the plug and take out the spring.The poppet can come out only by slanting the casing, and if not,remove it with pliers.

-Unloading valve(1): compensator
Remove the plugs from both sides and take out the spring and spool.

-Unloading valve(2)
Remove the plugs from both sides and take out the spring and spool.

Note:
The spool and stopper bolt are tightened with each other with adhesive applied to their threads, so they should not be separated unless required. by removing the stopper bolt,the poppet and spring can be taken out of the spool.

-Pilot spool and related parts.
Remove the plugs from both sides and take out the spring and push rod.

The pilot spool set can be pushed out from the push rod side with a Ø10 mm(Ø0.394 in) rod. When pushing,put the rod on the sleeve,not the spool.

Note:
The spool and sleeve cannot be separated from each other.

4) Reassembly
-Inspection of the disassembled parts.

Place all the disassembled parts side by side on a clean surface.Check o-rings for damage and replace defective ones.Inspect the friction surfaces of the spools,poppets,and casing for flaws like scratches.Correct slight flaw with an oil stone and wash corrected parts in a cleanser.

-Main spool and related parts.
When the head is disassembled,it should be tighten and locked securely using adhesive. Before retaining the spool with the snap ring E, make sure that the spool slides smoothing within the casing.

-Holding check valve and related parts

Put the poppet into hole B as shown in the figure and make sure that the poppet slides smoothly.Then put the spring in and tighten the plug,on which the O-ring must be installed,to the specified torque.

-unloading valve(1) and related parts.

Install the spool into hole C(Fig.9-19) in the correct direction.Put the spring in and tighten the plug to the specified torque.

-Unloading valve(20 and related parts.

Install the spool and confirm that the returns smoothly by the spring force after it is compressed by pushing the stopper bolt end and check that it slides smoothly.

-Pilot spool and related parts.

Be careful not to damage the O-ring during pilot spool installation.After assembly,make sure that the spool slides smoothly by pushing the push rod.

SECTION 6. TROUBLESHOOTING

Problems	Causes	Countermeasures
1.Lift does not rise	1) Insufficient engine speed	Raise engine speed slightly
	2) Insufficient transmission oil	Maintain oil level by replenishing with the same kind of oil
	3) Air taken in through suction	Tighten securely or replace broken parts.
	4) Clogged suction filter	Clean.
	5) Broken or poor hydraulic pump	Inspection pump and repair or replace if necessary.Pay particular attention to shaft seal because a broken seal sometimes intakes air.
	6) Poor link mechanism	Inspect,adjust,repair,or replace if necessary.(Refer to section 3)
	7) Excessive load on lift	Decrease load
	8) Broken cylinder	Replace
	9) Too low viscosity of transmission oil	As it will cause oil leaks or internal wear,replace with gear oil of SAE80
	10)Maladjusted relief valve	Readjust. (Cracking:refer to the specifications)
	11)Excessive internal leaks	Inspect cylinder and valves.Replace damaged seals,and repair. (Check each part systematically)
	12)Broken flow divider (Stuck sequential valve spool)	Disassemble and wash spool clean. If it is damaged seriously,replace it as an assembly.If damage is minor,correct surface with oil stone and finish by lapping.
	13)Broken control valve (Even when spool is shifted to up position,lift does not rise)	
	①Stuck compensator plunger (unloading valve 1)	Lap after repairing flaws with oil stone
	②Clogged orifices or slanted orifices in pilot passage.	Clean them with compressed air or a sharp point.
	③Stuck poppet(unloading valve 2)	Correct minor flaws with oil stone
	④Bitten or stuck check valve plunger	Lap after repairing flaws with oil stone
	14)Broken slow-return check valve	
	①Stuck poppet	Lap after disassembling,cleaning, and repairing flaws with oil stone

Problems	Causes	Countermeasures
2.Too low rising speed of lift	1)Above causes can also be possible	Repair according to above instructions.
	2) Too small a spool stroke in control valve	Inspect,readjust,or replace link mechanism if necessary.
	3)Broken compensator spring (unloading valve 1) in control valve	Replace spring.
	4)Stuck poppet (unloading valve 2)	Correct minor flaws with an oil stone
3.Lift lowers even when adjust knob is closed fully with adjust Handle (While engine is stopped)	1)Stuck poppet	Lap after disassembling,cleaning,repairing flaws with oil stone
	2)Poor valve seat	Replace valve
	3)Poor 0-ring	Replace
4.Lift does not lower	1)Slow-return-check valve knob is turned to the lock position	Turn knob to fast position
	2)Stuck poppet of slow-Return-check valve	Lap after disassembling, cleaning,repairing flaws with oil stone
	3)Seized lift shaft	Apply grease and repair or replace bushings or shaft if necessary.
	4)Stuck main spool	Lap lightly after disassembling, cleaning, and repairing flaws with oil stone or replace as an assembly.
5.Too slow lift lowering speed	1)Above mentioned causes can also be possible.	Repair or adjust according to instructions mentioned above.
	2)Insufficiently lowered control lever	Lower lever sufficiently
	3)Excessively closed slow-return check valve	Open valve sufficiently
6.When hydraulic control lever is raised,relief,valve beeps.	1) Maladjusted lever stopper check valve	Readjust lever stopper guide position
	2) Poor link mechanism	Inspect,readjust,repair,or replace link mechanism if necessary.
7.Fluid overheating	1)Excessively high working pressure	Inspect and adjust
	2)Too high or low viscosity of working fluid.	Replace with fluid of adequate viscosity.
	3)Insufficient fluid	Maintain specified level by replenishing

Problems	Causes	Countermeasures
8.Pump noise	1) Partially clogged suction filter or suction piping.	Clean.
	2) Air inhaled through suction piping and intake pipe connections for pump	Inspect and retighten.
	3) Loosened pump cover tightening bolts.	Inspect and retighten
	4) Too rich oil viscosity	Replace with fluid of adequate viscosity.
	5) Broken or worn pump parts	Inspect and replace defective parts.
9.Excessive wear,deflection or damage of pump	1) Dirty fluid	Eliminate foreign matter and inspect filters.
	2) Circuit pressure exceeds pump capacity	Adjust relief valve or replace if necessary
	3) Oil-less operation due to Insufficient oil quantity	Inspect transmission oil level and maintain specified oil level by replenishing.In either case,clean, and repair pump parts and replace damaged ones if necessary.
10.Oil leaks outside pump	Broken or fatigues oil seal or O-ring	Replace
11.Oil leaks from piping or joints	Poorly connected piping	Inspect,clean,and eliminate dust. Repair flaws with oil stone if necessary. Retighten.
	Poor O-ring	Replace
	Broken piping	Replace with a new one after washing clean related parts.
12.Oil leaks around lift arm	Poor oil seals	Replace oil seal or bushing if necessary
13.Independent PTO clutch slips or is too slow in engaging	1) Clogged fixed orifice of Flow divider	Disassemble and wash clean.
	2) Port B regulated pressure is too slow	Inspect and reset pressure
	3) Clogged PTO pressure control valve or stuck	Disassemble and wash clean. Repair flaws with oil stone if necessary or replace with a new one.
	4) Poor flow divider solenoid valve	Disassemble and repair or replace with new one if necessary .

Problems	Causes	Countermeasures
14.Independent PTO clutch is too quick in engaging	1) Stuck pressure-reducing valve spool	Lap after correcting flaws with oil stone
	2) Fatigued or broken pressure-reducing valve spring	Replace.
	3) Worn or broken sealing of PTO clutch	Replace
	4) Worn friction plates or driven plates	Replace
	5) Overheated fluid	Refer to paragraph for "fluid overheating"
	6) Port B regulated pressure is too high of Flow-divider	Inspect and reset pressure
	7) Stuck pressure-reducing valve spool	Lap after correcting flaws with oil stone
	8) Clogged orifice in pressure-reducing valve spool	Clear clogged with compressed air or with a sharp point.

Chapter 10
Electrical accessory and instruments

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Chapter 10 Electrical accessory and instruments

SECTION 1. GENERAL DESCRIPTION

The basic electrical system of tractors consists of the engine cranking system ,battery charging system,lighting system,meters,switches,etc.
For further information concerning the engine cranking equipment and battery charging equipment, please refer to the engine manual.
The battery is a power source to activate the engine cranking system,lighting system,and other electrical equipment.The lighting system is used to activate the illumination lights,indicators,and signal lights.The meter is a device that enables the operator to be aware of the present operating conditions;oil pressure gauge,water temperature gauge(thermometer),fuel gauge,etc.are installed.
All the controls,meters, and indicators are arranged around the operator's seat for easy Maneuverability readability,and convenience.

SECTION 2. SPECIFICATIONS

MODEL			T303HST/T353HST	
PART NAME			Specification(w)	Quantity
1.lighting system	Head lights		50/40	2
	Front combination lights	Turn signal lights Small lights	21 5	2 2
	Rear combination lights	Turn signal lights Stop lights Tail light	21 21 5	2 2 2
2. Monitoring system	Meter assembly	Hour meter Fuel gauge Thermometer Pilot light	- - - (3.4)	1 - - 15
	Horn		-	1
3.Fuses	Fuses(A)	In main fuse box (with spare fuse)	15 10	4 6
	Fusible links	0.85 1.25	- -	1 1
4.Battery			12V75AH	1

SECTION 3. BATTERY

1.INSPECTION

1.1 INSPECTION OF ELECTROLYTE LEVEL

As the battery repeats charging and discharging during operation.The water content in the electrolyte gradually evaporates, and as a result,the level should be inspected at the specific level;replenish with distilled water.

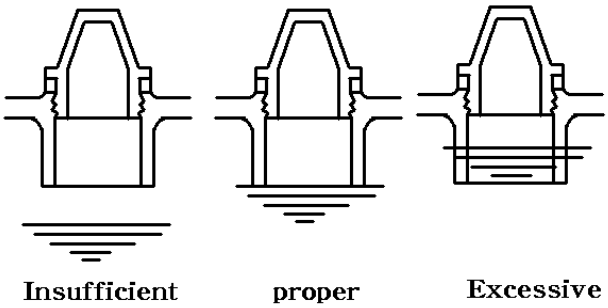


Fig.10-1 electrolyte level

1.2 INSPECTION OF ELECTROLYTE SPECIFIC GRAVITY

The specific gravity of the electrolyte lowers as the battery discharges,so the battery condition can be determined by measuring the specific gravity.The specific gravity can be measured generally with a suction type hydrometer which must be read properly as shown in Fig. 10-2

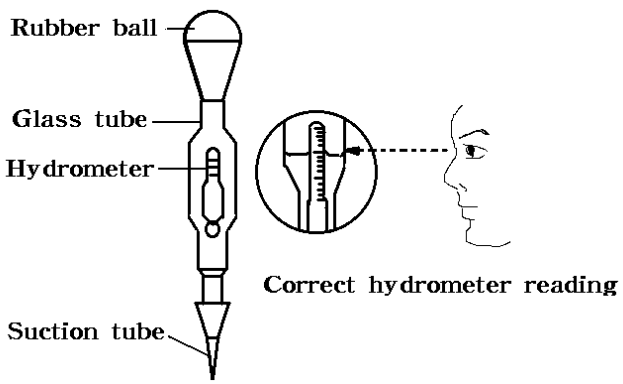


Fig.10-2 electrolyte gravity

Note:
When the distilled water is added,charge the battery to mix it well into the electrolyte before measuring the specific gravity.

a.Temperature correction of the hydrometer reading

The specific gravity of the battery electrolyte(diluted sulfuric acid) varies with the temperature of the electrolyte at a rate 0.0007 specific gravity point for each 1℃ change in temperature.Therefore, when the specific gravity of the electrolyte in the battery is measured with a suction type hydrometer,a temperature correction should be made,using the following formula to permit the direct comparison of the measured valve with the standard specific gravity at 20 ℃.

S_{20} :St+0.0007(t-20)

S_{20} :Specific gravity at standard temperature of 20 ℃.

t : Temperature of the electrolyte at the time of measurement

St : Specific gravity of the electrolyte measured at t ℃.

1.3 BATTERY CHARGING

If the specified gravity of the battery electrolyte in lower than 1.220 (at 20 ℃),the battery should be recharged,because leaving an undercharged battery without recharging it will lead to permanent battery damage.The battery is subject to self-discharge at a rate as shown in the table below.Therefore it should be recharged from time to time when storing the battery unused for a long period of time.

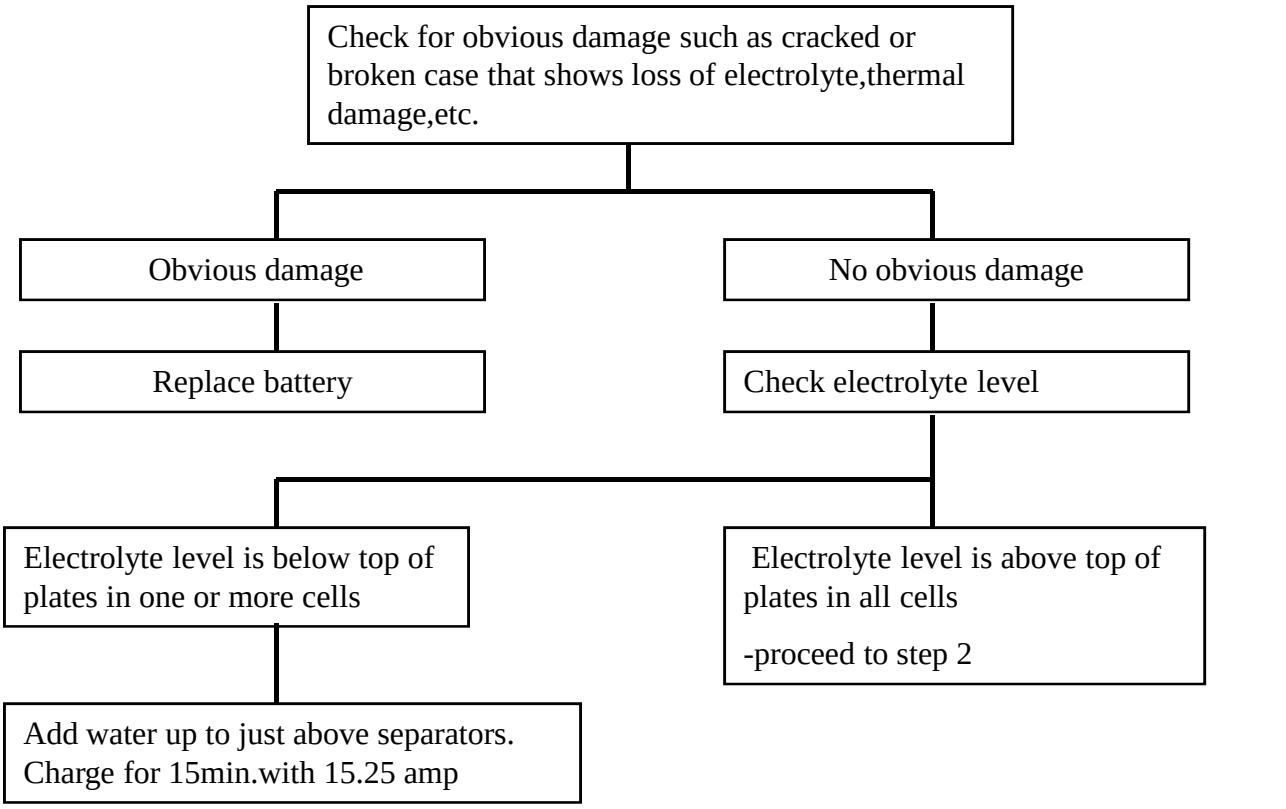
When recharging the battery,wash clean the outside of the battery case and the battery posts.Check the level of the electrolyte in each cell and replenish with distilled water as necessary.

Temperature	Self-discharge rate per day (%)	Decrease in specific gravity per day
30 ℃	1	0.002
20 ℃	0.15	0.001
5 ℃	0.025	0.005

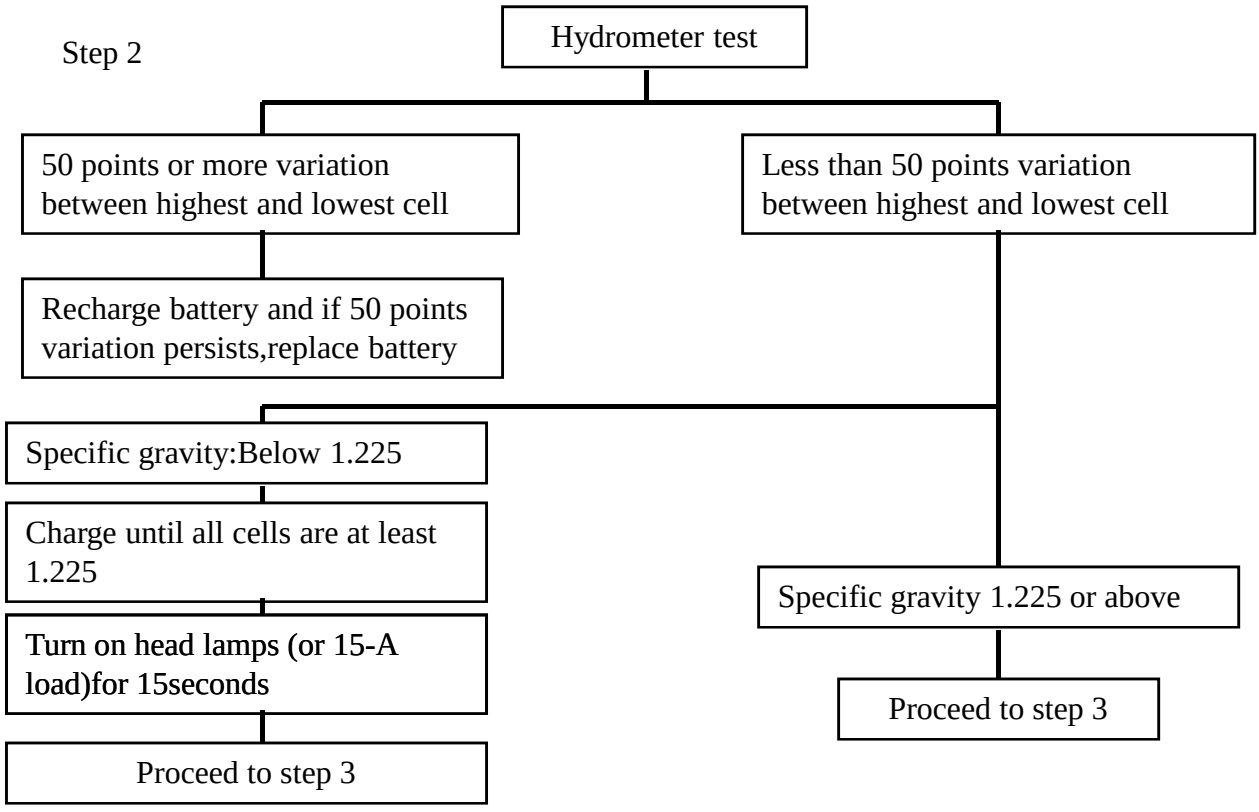
1.4 BATTERY TESTING CHARTS

Step 1.

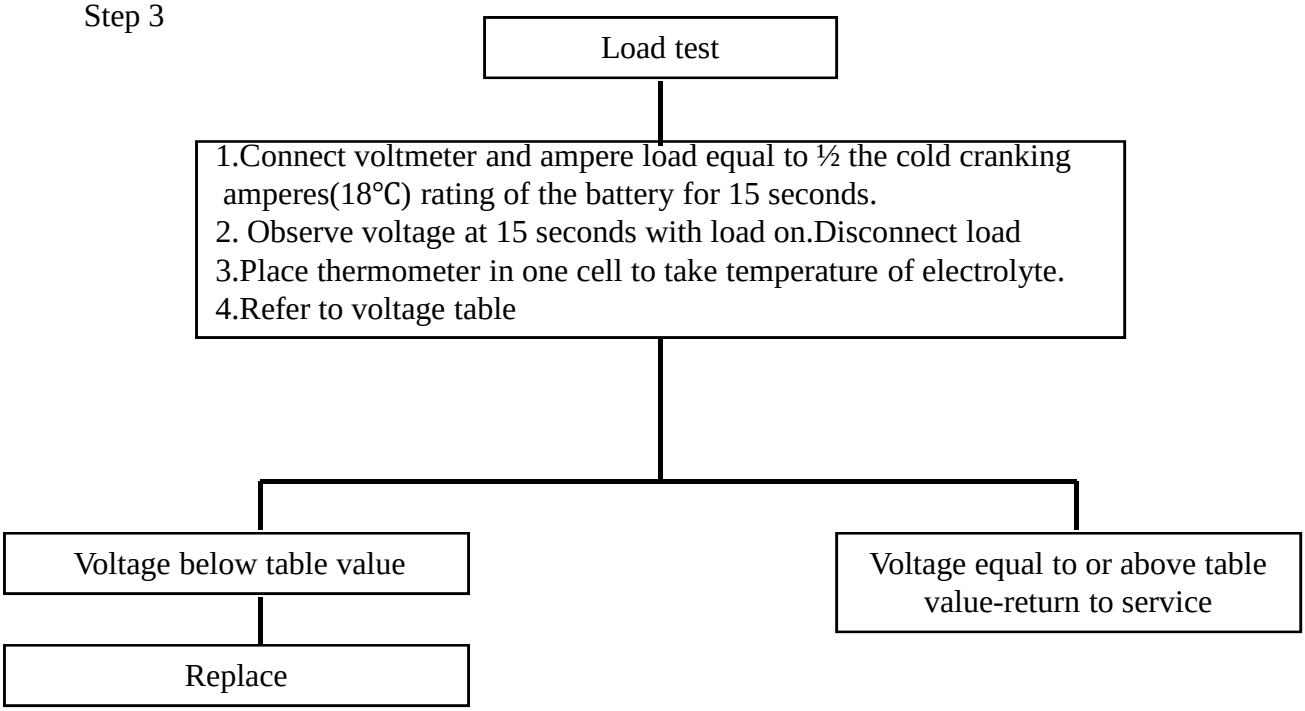
VISUAL INSPECTION


Check for obvious damage such as cracked or broken case that shows loss of electrolyte,thermal damage,etc.
Obvious damage
No obvious damage
Replace battery
Check electrolyte level
Electrolyte level is below top of plates in one or more cells
Electrolyte level is above top of plates in all cells
-proceed to step 2
Add water up to just above separators. Charge for 15min.with 15.25 amp

Step 2


Hydrometer test
50 points or more variation between highest and lowest cell
Less than 50 points variation between highest and lowest cell
Recharge battery and if 50 points variation persists,replace battery
Specific gravity:Below 1.225
Charge until all cells are at least 1.225
Turn on head lamps (or 15-A load)for 15seconds
Proceed to step 3
Specific gravity 1.225 or above
Proceed to step 3

Step 3


Load test
1.Connect voltmeter and ampere load equal to ½ the cold cranking amperes(18℃) rating of the battery for 15 seconds.
2. Observe voltage at 15 seconds with load on.Disconnect load
3.Place thermometer in one cell to take temperature of electrolyte.
4.Refer to voltage table
Voltage below table value
Replace
Voltage equal to or above table value-return to service

Voltage table	
Estimated electrolyte temperature	Minimum required voltage under 15 sec.load (Use ½ these values for 6-V batteries)
70 °F (21 ℃) and above	9.6
60 °F (16 ℃)	9.5
50 °F (10 ℃)	9.4
40 °F (4 ℃)	9.3
30 °F (-1 ℃)	9.1
20 °F (-7 ℃)	8.9
10 °F (-12 ℃)	8.7
0 °F (-18 ℃)	8.3

SECTION 4. METERS AND SWITCHES

1.METERS

1.1 Removal

a. Disconnect the cable from the negative post.
b. Remove the philips screw which hold the meter panel and lift up the panel assembly a little

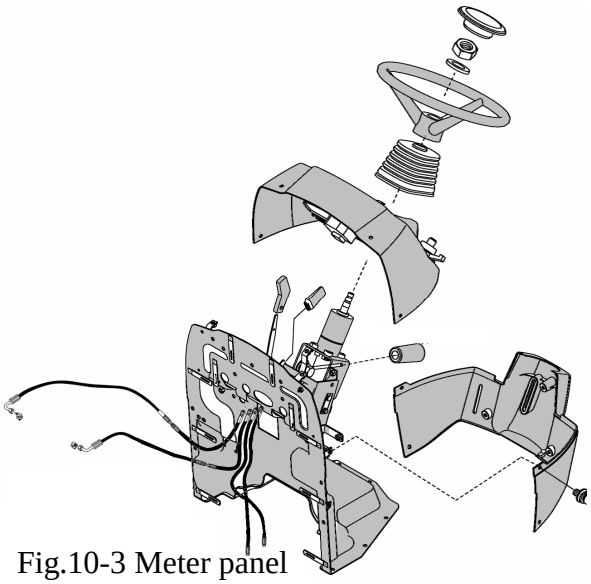


Fig.10-3 Meter panel

c. Then the meter panel can be detached by removing the wire harness couplings.

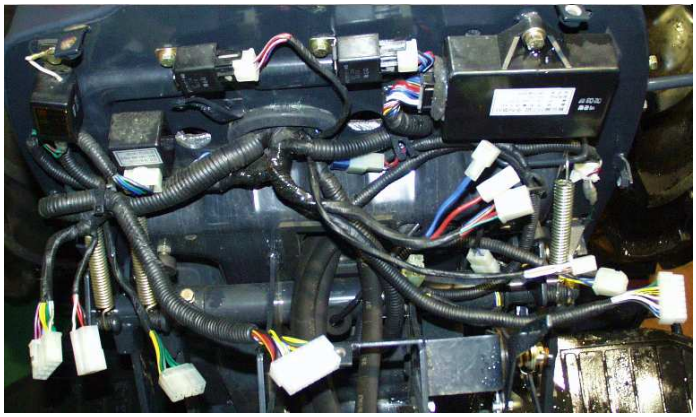


Fig.10-4 Wire harness

1.2 Tacho/hour meter and sensor

a.Construction

An electric tachometer is employed along with a Tachosensor.The tach/hour meter converts engine revolutions to electric signals,which is sent to the tachometer.The tachometer displays the engine revolutions visually.The tachosensor generates 14 pulses per one engine revolution.

The generated pulses are converted into voltage output through a converter.Then the voltage is divided into three different phase coils through a IC circuit.The tachometer pointer is swung by the compound magnetic field generated by the three point.

b. Inspection

-Tachometer

The allowable error of a tachometer reading is specified as shown on the table below.If the reading deviates from the specified value.replace the meter assembly.

Engine speed(rpm)	1000	2500
Allowable error(rpm)	±150	±150

1.3 Fuel gauge and Fuel gauge sensor

a.Construction

When the fuel tank is full,the float is at the top and has moved the variable resister to a position of least resistance.This feeds maximum current into the meter circuit and the pointer swings fully to the F position.Consequently when the fuel level in the tank is low,everything acts in reverse.

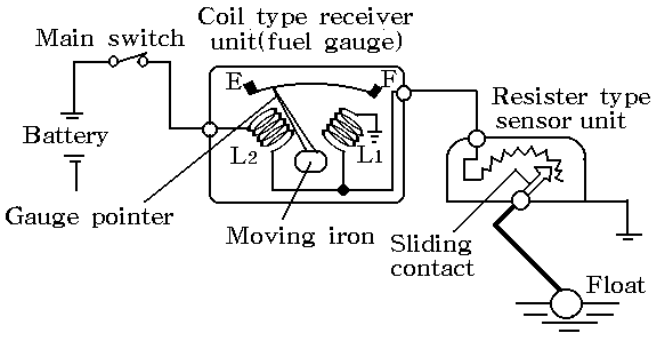


Fig.10-5 Fuel gauge sensor

b.Inspection

-Fuel meter
Connect the fuel gauge to form a circuit with the resisters as shown Fig.10-6 and check to see if the gauge pointer swings to each position: F.1/2 and E by changing the resistance value.
If it does not,change the gauge assembly.

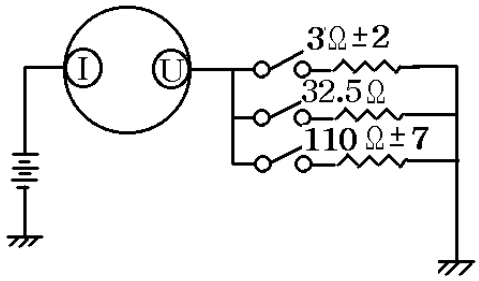


Fig.10-6

-Fuel gauge sensor(variable resistor)
Check each resistance value with a tester at each float position as shown in Fig.10-7.if the measured values are deviated from respective specified values,replace the sensor assembly.

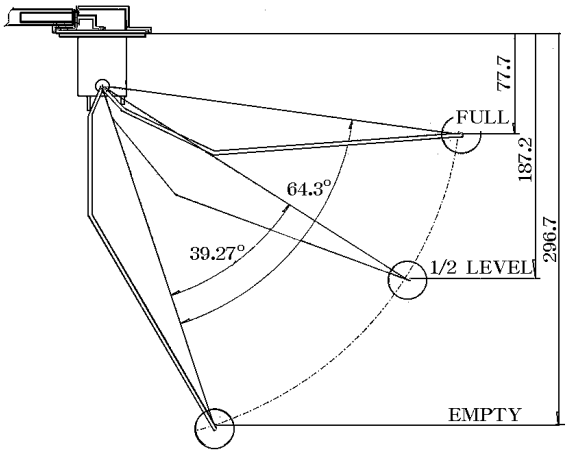


Fig.10-7

Standard pointer position	F	(1/2)	E
Regulated resistance(Ω)	3	32.5	110
Allowable error(Ω)	±2	(±4)	±7

Note:
1) Figures in parentheses are reference value
2) Inspect each position in order F to E
3) Read values in three minutes.

1.4.Thermometer

a. Construction
This is the same moving magnet type meters as the fuel gauge.As the coolant temperature becomes higher,the resistance in the thermo unit(sensor) become lower,which results in more current to the meter circuit and swinging the meter pointer to the high temperature side on the scale.Of course,as the coolant temperature become lower,everything acts in reverse.

b. Inspection
Normally the thermometer resisters higher values as the coolant temperature rises after the engine is running.If it does not,check the wiring first.If the wiring is normal.Replace assembly.

2. STARTER SWITCH

(1) Removal
a. Remove the dash cover(Upper)
b. Remove the ring nut holding the starter switch using a conventional screw driver.
c. Pull out the key switch as shown in Fig.10-8

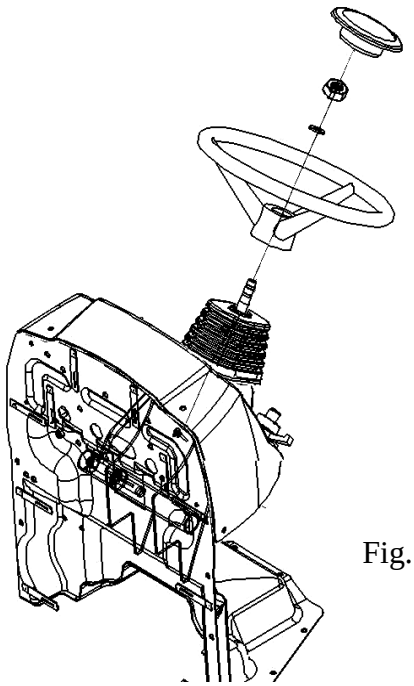


Fig.10-8

(2) Inspection

a.The main switch circuit,switching positions, and terminals are as shown in the figures. Check the continuity across respective terminals referring to the switch circuit diagram. Replace a defective switch as an assembly

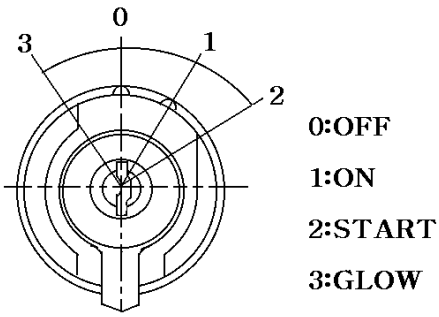


Fig.10-9

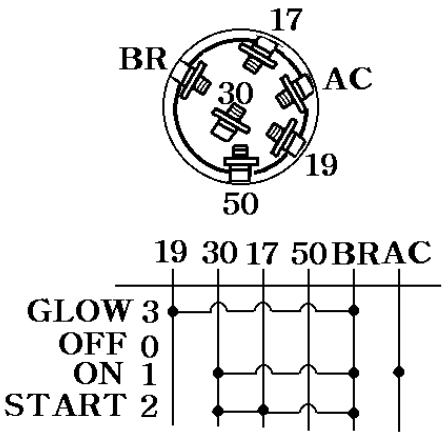


Fig.10-10

3. COMBINATION SWITCH

1) Removal

(1) Remove the meter panel
(2) Remove the light switch knob and turn signal switch lever.

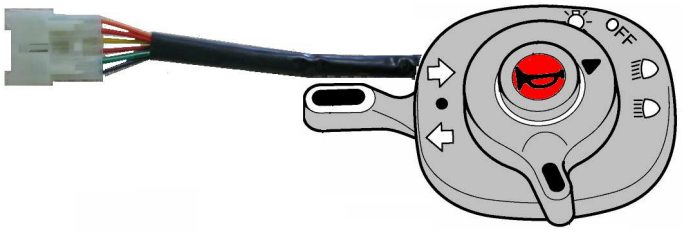


Fig.10-12

(3) Release the ring nut with a conventional screw drive(-) and remove the combination switch.

2) Inspection
Each switch circuit is as shown,so check each switch for a continuity across respective terminals with a tester.Replace a defective switch as an assembly.

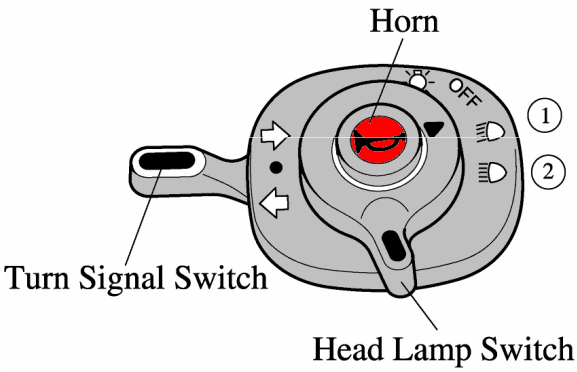


Fig.10-13 combination switch

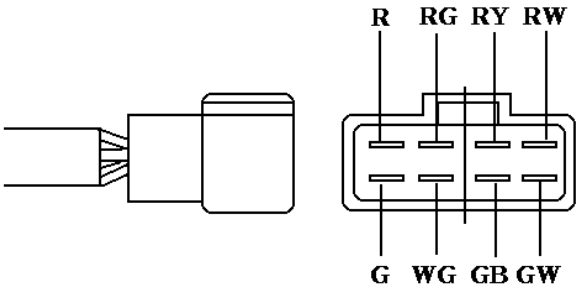


Fig.10-14 Harness socket

-Lighting

Color code	RY	Y	BR	O
	B1*1	T	1	2
OFF **2				
1	●	●	●	
2	●	●		●

*1 :Terminals

**2: Switching positions

-Flasher

Color code	G (Green)	WG (White/ Green)	GB (Green/ Black)
	B2*1	R	L
1**2	●	●	
OFF			
2	●		●

*1 :Terminals

**2: Switching positions

-Horn switch

Color code	B	LW
	B1*1	H
Free**2		
Push	●	●

*1 :Terminals

**2: Switching positions

4. STOP LIGHT SWITCH

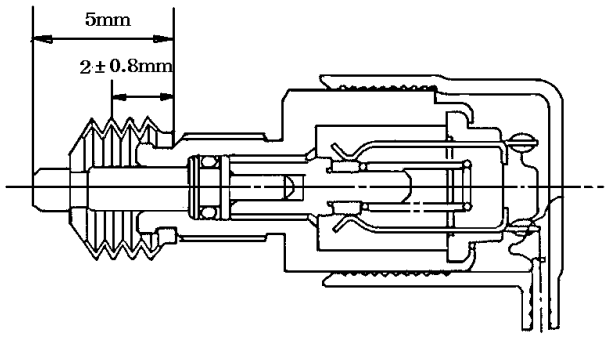


Fig.10-15 Stop light switch

Capacity	15 A (DC12V)
Stroke to ON	2 ±0.8mm
Total stroke	5mm

5.RELAY UNIT

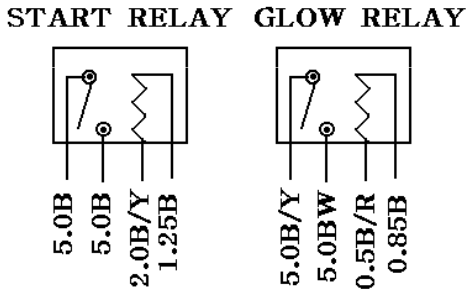


Fig.10-16 Relay unit

6. FUSE

Fuses are installed in the main fuse box and one for the headlights.Three fusible links are installed to prevent the wiring from burning due to a short circuit.

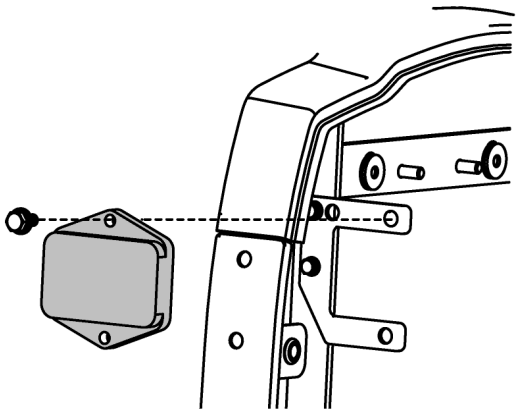


Fig.10-17 Fuse box

Each fuse is connected as follows

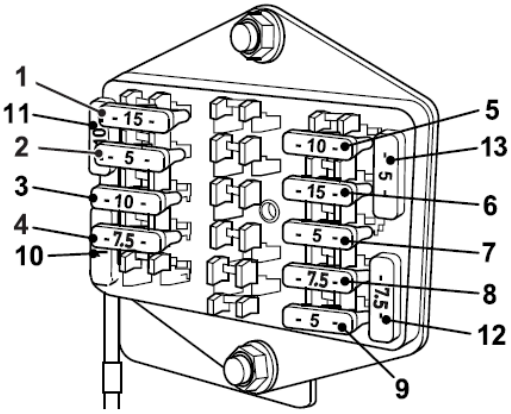


Fig.10-18

1	Light / Horn	15A
2	Panel	5A
3	Turn Signal Lamp	10A
4	Working Light	7.5A
5	Hazard	10A
6	Coupler	15A
7	Controller Glow Timer	5A
8	PTO, Cruise, Engine Stop	7.5A
9	Stop Lamp	5A
10	Spare	-
11	Spare	-
12	Spare	-
13	Spare	-

The circuit has 8 blade type fuses in its wiring circuit.When a fuse has blown replace it with one of the same value.

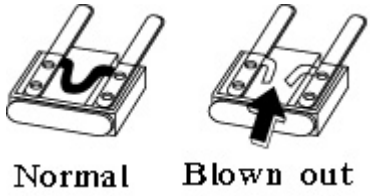


Fig.10-19

Note:

Using a large capacity fuse or wire burn out the wiring system.

Use fuse tongs to replace fuses

7. CONTROLLER

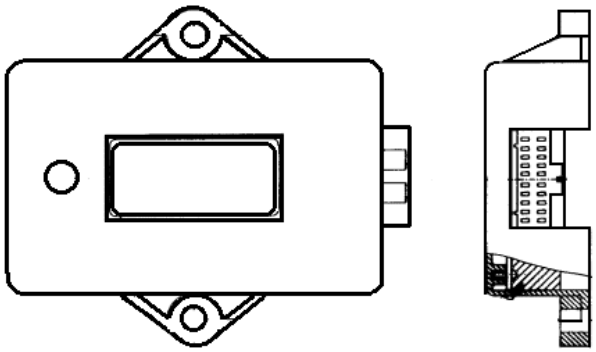


Fig.10-20

Capacity	DC12V
Operating range	DC10~16V
Operating temperature	-15~80ºC

1.Function

a. Engine stop
When below condition is performed,Engine will be stopped within 10±3 sec.(1st)

No	Seat S/W	Brake S/W	PTO S/W	HST S/W
1	OFF	ON	ON	ON
2	OFF	ON	ON	OFF
3	OFF	OFF	ON	ON
4	OFF	OFF	OFF	ON
5	OFF	OFF	ON	OFF
6	OFF	OFF	OFF	OFF

Note:
When the seat S/W is Off position,engine will stop after 3 seconds.

b. Engine Start control
Engine can be started on the condition of Brake S/W ON ,HST S/W,and PTO S/W OFF Position

c. Cruise control
When Cruise momentary S/W is operated as Procedure OFF→ON→OFF.it will change the output of Cruise magnetic.And ON output relay will operate to light the cruise lamp.

2. CIRCUIT DIAGRAM

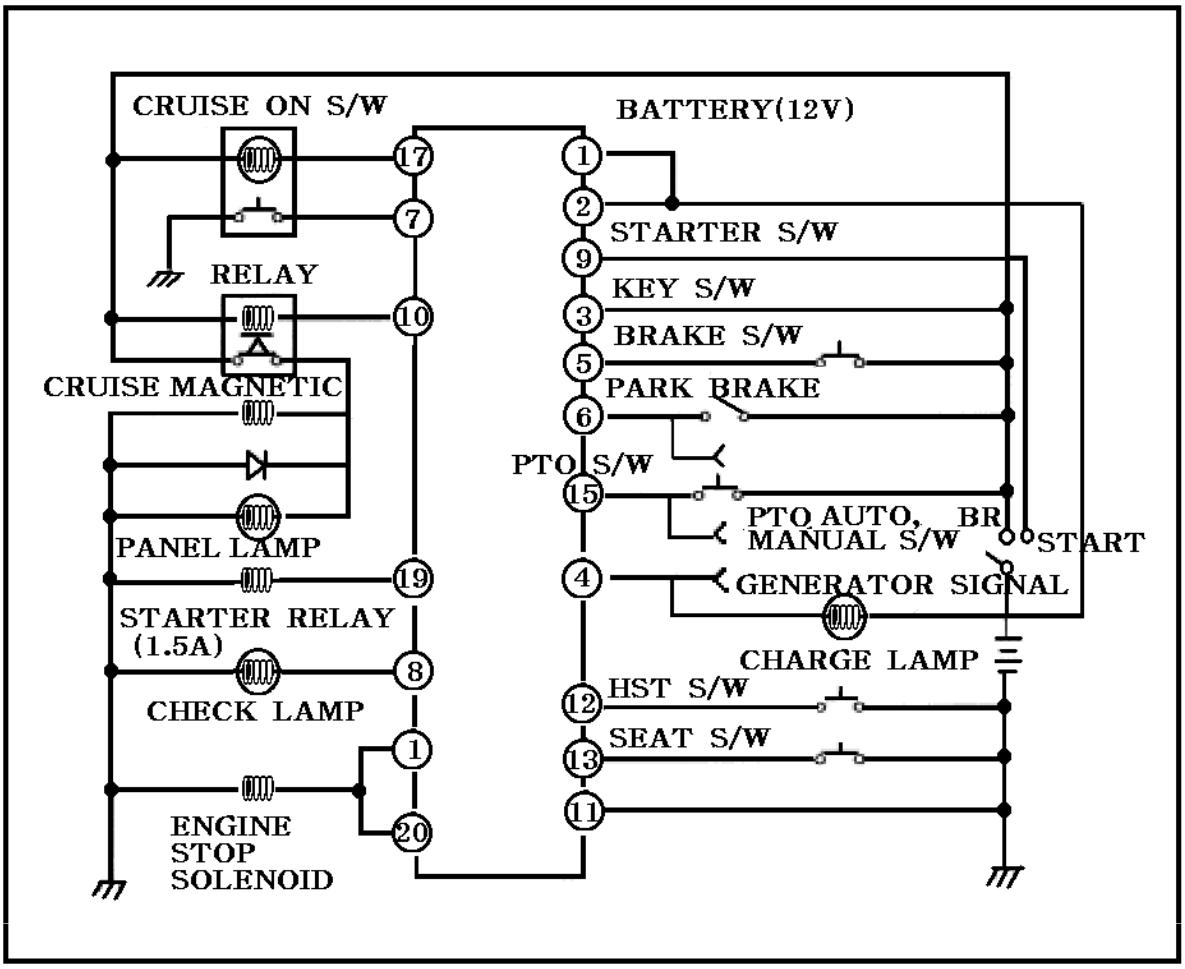


Fig.10-21 controller

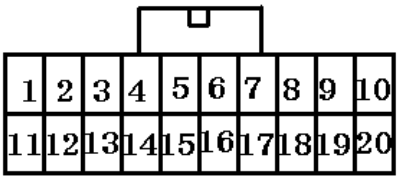
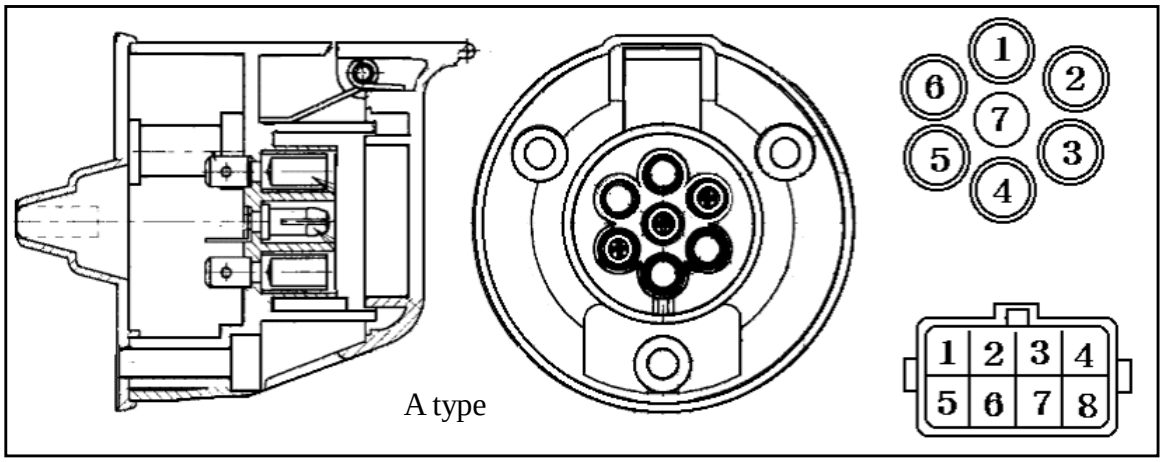


Fig.10-22 connector

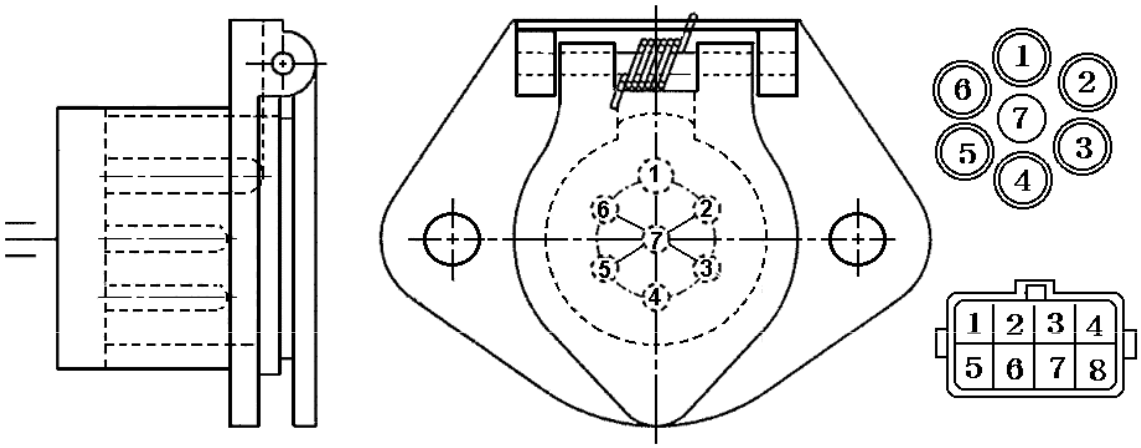
1.Battery(+12V)
2.Battery(+12V)
3.Hey(+12V)
4.Generator charger signal
5.Brake S/W
6.Parking brake S/W
7.Cruise S/W
8.Check valve
9.Starter S/W
10.Engine stop solenoid
11.GND
12.HST S/W
13.Seat S/W
14.N.C
15.PTO S/W
16.N.C
17.Cruise lamp
18.Cruise magnetic
19.Starter relay
20.Engine stop solenoid

8.Trailer socket

A hella's 7-pin trailer socket is equipped as a standard equipment.Lamp on a trailer can be operated through the socket.



A type



B type

Fig.10-23

Socket No.	Description	Color		Specification	Wire Housing
		A type	B type		
1	Earth	B	W	AV 1.25	1
2	Small light(Tail light)	Y	B	AV 1.25	2
3	Turn signal (LH)	GB	Y	AV 1.25	3
4	Stop Light	WL	R	AV 1.25	4
5	Turn signal (RH)	GY	G	AV 1.25	5
6	Rear Light (License plate)	YW	Br	AV 1.25	6
7	Reserve light	WG	L	AV 1.25	7

Note:

Lamp on the trailer should be of the same size or smaller than those on the trailer.

SECTION 5. EARTHING POINT

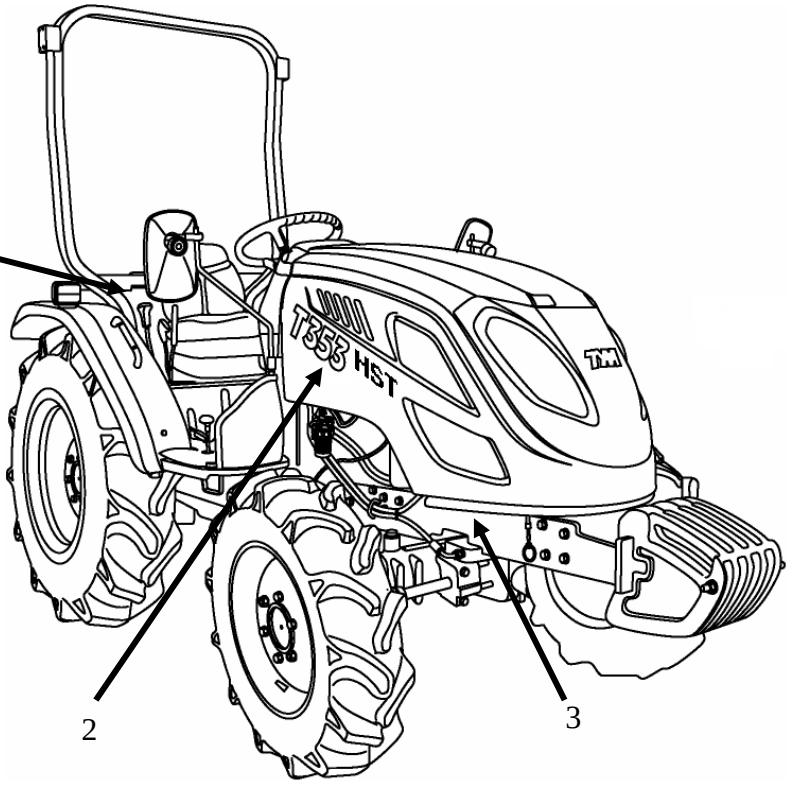


Fig.10-24

1) Fuel tank guard (RH)

Earthed at tapped hole in the lower the working lamp

Fig.10-25

2) Contact surfaces of the Hood frame and bracket where they tightened together

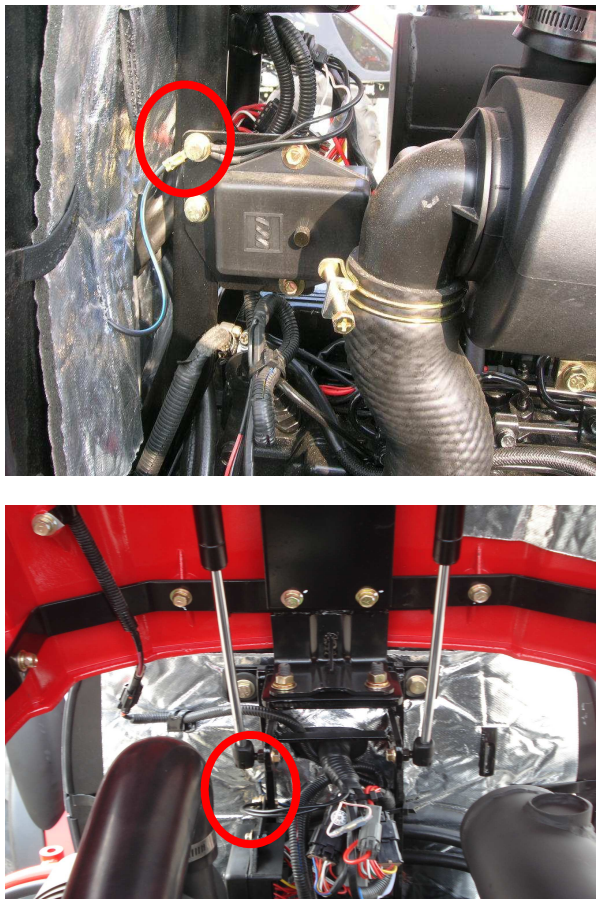


Fig.10-26 Hood frame

3) Right surface of the frame comp.Where the battery cable is to be installed.

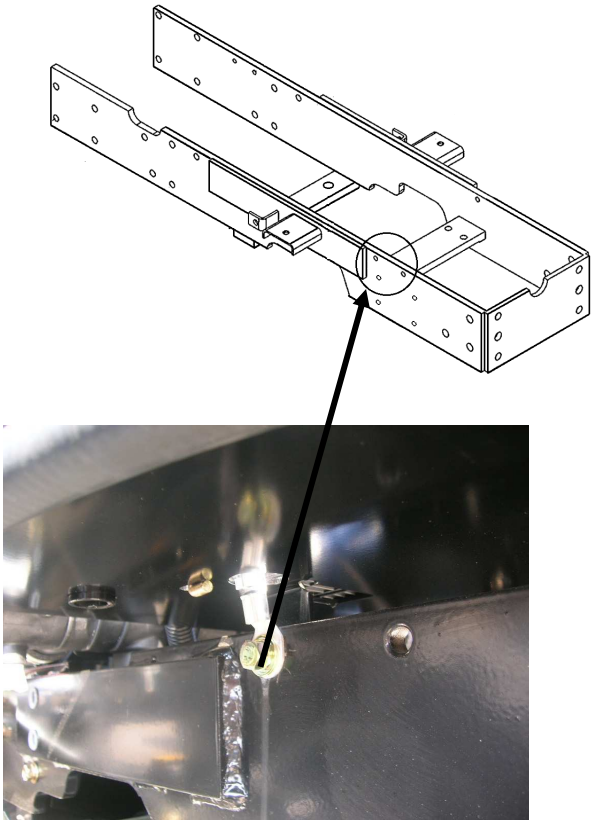
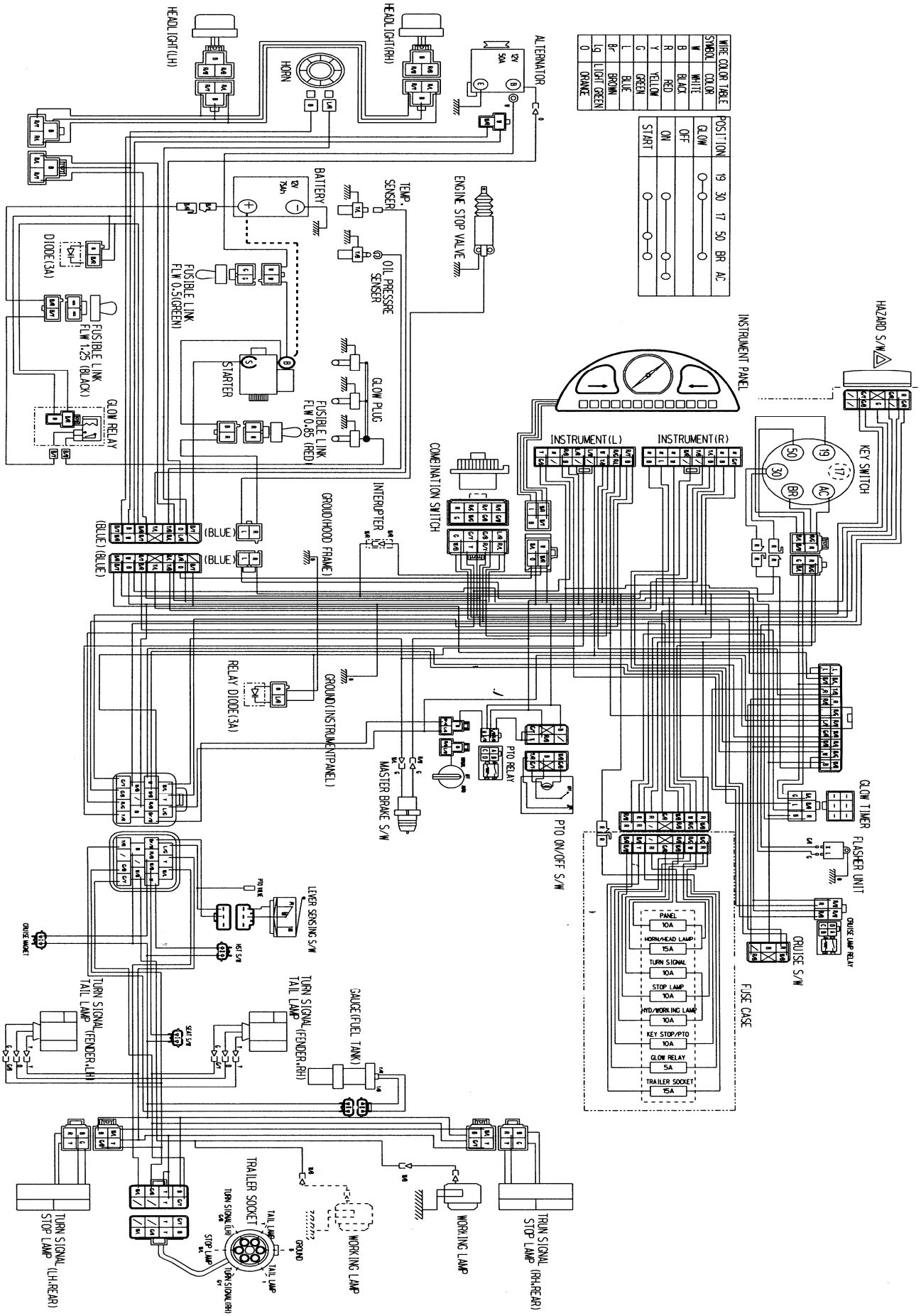


Fig.10-27 Battery cable

SECTION 6. WIRING DIAGRAM



SECTION 7. TROUBLESHOOTING

Important: Whenever effecting a repair the reason for the cause of the problem must be investigated and corrected to avoid repeating failure.

The following table lists problems and their possible causes with the recommended remedial action

1. LIGHTING SYSTEM

Problems	Causes	Countermeasures
Several or all lights do not illuminate	Discharged battery	Check battery and charge or renew
	Loose or defective battery cable connection	Inspect,clean,and tighten connection
	Loose wire harness connectors	Check and ensure connectors securely engaged
	Burnt out fuse or fusible link	Inspect and renew.Check circuit before re-connecting power
	Faulty wiring	Check lighting Circuit wiring and repair or renew
	Defective light switch	Check and renew
	Several light bulbs burnt out due to defective voltage regulation	Check and renew voltage regulator (Alternator)
Individual lights do not illuminate	Burnt out bulb	Check and renew
	Defective or corroded bulb contact	Inspect,clean or renew
	Burnt out fuse	Inspect and renew.Check circuit before reconnecting power
	Loose or broken wires	Inspect ,secure,repair,or renew wiring
	Poor ground connection	Inspect,clean, and tighten ground connection
Lights burnt out repeatedly	Faulty voltage regulator	Check and renew voltage regulator (Alternator)
Turn signal lights do not illuminate	Blown fuse	Inspect and renew.Check circuit before re-connecting power
	Inoperative flasher unit	Check and renew
	Inoperative turn signal switch	Check and renew
	Defective wiring or connections	Inspect circuit,clean,and tighten connection. Repair or renew wiring if necessary

Problems	Causes	Countermeasures
Individual turn signal light does not illuminate	Burnt out bulb	Check and renew
	Corroded or loose bulb contacts	Inspect,clean,and renew
	Poor ground connection or damage wiring	Inspect,clean,and tighten connections or renew wiring
Turn signal pilot light is inoperative	Faulty bulb	Check and renew
	Defective flasher unit	Check and renew
	Faulty wiring or connections	Inspect,clean,and tighten connections or renew wiring
Stop lights does not illuminate	Inoperative stop light switch	Check and renew
	See “Individual lights do not illuminate”	See “Individual lights do not illuminate
Inoperative work light	Work light switch is not turned on	Ensure work light illuminates
	See “Individual lights do not illuminate	See “Individual lights do not illuminate

2. INSTRUMENTATION

Problems	Causes	Countermeasures
Inoperative or erratic meters	Loose or broken wiring	Inspect Circuit, tighten connections or renew wiring
	Defective meters	Inspect and renew
	Defective sensors	Check and renew
	Defective Voltage regulator	Check and renew voltage regulator (Alternator)
Monitor light does not illuminate	Loose or broken wiring	Inspect circuit,tighten connections or renew wiring
	Faulty main switch	Check and renew
	Burnt out bulb	Check and renew
	Burnt out fuse	Check and renew
	Defective switch	Check and renew
	Loose or broken wiring	Check and renew
PTO does not operate	Burnt out fuse	Inspect and renew.Check circuit
	Loose or broken wires or connections	Inspect circuit,tighten connections,or renew wiring
	Defective PTO switch	Check and renew
	Defective PTO solenoid	Check and renew

Problems	Causes	Countermeasures
Inoperative horn	Burnt out fuse	Inspect and renew.Check circuit before re-connecting power
	Loose or broken wires of connections	Inspect circuit,tighten connections,or renew wiring
	Defective horn switch	Check and renew
	Defective horn	Check and renew
Cruise does not operate	Burnt out fuse	Inspect and renew.Check circuit before re-connecting power
	Loose or broken wire	Inspect circuit,tighten connections,or renew wiring
	Loose the magnetic assembly	Inspect circuit,tighten connections

3.GLOW SYSTEM

Problems	Causes	Countermeasures
All glow plugs do not heat red	Discharged Battery	Check battery and charge or renew
	Loose or defective battery cable connections	Inspect,clean,and tighten connections
	Loose wire harness connections	Check and ensure connectors securely engaged
	Burnt out fusible link	Inspect and renew.Check circuit before re-connecting power
	Faulty wiring	Check glow plug circuit wiring and repair or renew
	Defective main switch	Check and renew
Individual glow plug does not glow	Defective glow plug	Check and renew
	Defective or corroded glow plug contacts	Inspect,Clean,or renew
	Loose or broken wires	Inspect,secure,repair,or renew wiring
Glow monitor light does not illuminate	Defective glow timer	Check and renew
	Defective glow monitor light or monitor and warning check unit	See”Light system troubleshooting”

4. STARTING SYSTEM

Problems	Causes	Countermeasures
Starter motor does not spin	Discharged battery	Check battery and charge or renew
	Defective stop light switch	Check and renew
	Defective key switch	Check and renew
	Defective starter motor connections or loose battery connections	Check,clean and tighten connections
	Faulty starter motor	Inspect,repair,or renew
	Defective master brake pedal	Inspect and try to push brake pedal
	Faulty reverse or forward pedal	Inspect ,adjust neutral
	Defective push switch	Check and renew
	Defective controller	Check and renew
Engine cranks slowly	Discharged battery	Check battery and charge or renew
	Excessive resistance in starter circuit	Check circuit connections and repair or renew faulty wiring
	Defective starter motor	Refer to the engine manual
	Tight engine	Refer to the engine manual

5. CHARGING SYSTEM

Problems	Causes	Countermeasures
Battery is low in charge or discharge	Loose or worn alternator drive belt	Check and adjust belt tension or renew
	Defective battery:It will not accept or hold charge.Electrolyte level is low	Check condition of battery and renew
	Excessive resistance due to loose charging system connections	Check,clean,and tighten circuit connections
	Defective alternator	Check and repair or renew
Alternator is charging at high rate (Battery is overheating)	Defective battery	Check condition of battery and renew
	Defective Alternator	Check and repair or renew
No output from alternator	Alternator drive belt is broken	Renew and tension correctly
	Loose connection or broken cable in charge system	Inspect system,tighten connections and repair or renew faulty wiring
	Defective voltage regulator	Check and renew
	Defective alternator	Check and repair or renew

Problems	Causes	Countermeasures
Intermittent or low alternator output	Alternator drive belt is slipping	Check and adjust belt tension or renew
	Loose connection or broken cable in charge system	Inspect system,tighten connections and repair or renew faulty wiring
	Defective alternator	Check and repair or renew
Warning light dims	Faulty external charging circuit connections	Inspect system,clean and tighten connections
	Faulty rotor slip rings or brushes	Inspect and repair or renew
	Defective monitor and warning unit	Check and renew
	Faulty rectifier or rectifying diodes	Check and renew
Warning light is normal but battery is discharged	Defective voltage regulator	Check and renew
	Faulty starter	Check and renew
	Faulty rectifier or rectifying diodes	Check and renew
Warning light is lit during operation	Loose or worn alternator drive belt	Check and adjust tension or renew
	Defective diodes	Check and renew
	Faulty rotor,slip rings,or brushes	Inspect,repair,or renew
	Defective starter	Check and renew
	Defective rectifier or rectifying diodes	Check and renew
Warning light flashes intermittently	Faulty external charging circuit	Inspect circuit,clean,and tighten connections.Repair or renew faulty wiring
	Alternator’s internal connections	Inspect and test circuitry,Repair or renew

CHAPTER 11.
Service standards and other information

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CHAPTER 11. Service standards and other information

SECTION 1. SERVICE STANDARDS.

Part names and inspection items	Nominal dimensions	Standard value for reassembly	Usable limits	Service instructions and remarks

1.ENGINE ACCESSORIES(CHAPTER 3)

1) RADIATOR

Coolant capacity	2.5 ℓ		Radiator alone
	7ℓ		Whole cooling system
Radiator cap valve operating pressure	0.9 ±0.15㎏f·㎠		

2) AIR CLEANER

Element capacity	Maker :Donaldson Model :FPG 057512(Dual element) Filtering efficiency:99.9% or more Temperature:-30~80°C	

OUTER ELEMENT

1. Clean or wash the element after 100 hours of operation.Replace a damaged on or one which has been used more than 500 hours.

a.Cleaning (when dust is dry)
Apply compressed air of 7Kgf/㎠ or lower to the inside of the element to blow dust outwards.
Never strike element to dust.

b.Washing(when dust is wet or oily)
Dissolve element cleanser or neutral detergent of good quality in water.Keep the element immersed in the solution about 30 minutes and then wash it by shaking gently.
-Then,rinse it in fresh water;Water pressure should be less than 2.8 Kgf/㎠.
-Leave the washed element in a shaded,well-ventilated place to dry itself.
Never force-dry heat or compressed air.

2. An element which has been washed five times should be replaced with a new one.
3. When the tractor is used in dusty situation,Inspect the element everyday and clean if necessary

Part names and inspection items		Nominal dimensions	Standard value for reassembly	Usable limits	Service instructions and remarks

2.CLUTCH DAMPER

Spline hub	No.of teeth	20			
	Large diameter		Ø22.35		
	Small diameter		Ø19.9		

3. TRANSMISSION (CHAPTER 5)

1) FRONT AND SPACER TRANSMISSIONS

TRANSMISSION OIL CAPACITY				35ℓ(9.25 US gal)
SHIFTER DISENGAGING LOAD				
Front wheel drive		4 - 6 ㎏f		Measure at the shifter
Individual gears back lash		0.1 ~0.2 ㎜	0.5 ㎜	
Independent Rear PTO clutch	Disk thickness	2.6 ±0.1 ㎜	2.3 ㎜	
	Disk flatness		0.2 ㎜	
	Driven plate flatness		0.2 ㎜	
	Brake disk thickness	3.0 ±0.1㎜	2.5 ㎜	
	Brake disk flatness		0.2 ㎜	

2) REAR TRANSMISSION

(1) DRIVE PINION & RING GEAR

Starting torque		0.08 - 0.11 ㎏·m		
Backlash		0.1 ~ 0.2 ㎜	0.5 ㎜	
Drive pinion and ring gear support shimming	Adjustment of relative positioning between drive pinion and ring gear		Available shims on drive pinion metal(support) Shim A : 0.1 ㎜ Shim B : 0.2 ㎜ Available shims on dif-case Shim A : 0.1 ㎜ Shim B : 0.2 ㎜	

Part names and inspection items	Nominal dimensions	Standard value for reassembly	Usable limits	Service instructions and remarks

(2) DIFFERENTIAL

Backlash between dif-pinion and dif-side gear		0.1 ~ 0.2 ㎜	0.5 ㎜	Pinion thrust collar or gear

4.FRONT AXLE (CHAPTER 6)

1) Front drive axle (4WD)

Tire inflation		Front : 2.2 ㎏f/㎠ Rear : 1.8 ㎏f/㎠			
Wheel alignment		①Toe-in : 2 ~ 6 ㎜ ②Camber : 3 °±1 ° ③Caster : 1 °±1 ° ④Rocking angle : 5 °±1 ° ⑤Steering angle : 52°±1°			
Front center pivot	shaft.dia.		Ø 50 ㎜	Ø 49.9 ㎜	wear limit : 0.1 ㎜
	bush	50 × 55 × 20	Ø 50 ㎜	Ø 55.35 ㎜	wear limit : 0.2 ㎜
Rear center pivot	shaft.dia.		Ø 75 ㎜	Ø 74.9 ㎜	wear limit : 0.1 ㎜
	bush	75 ×80 ×30	Ø 75 ㎜	Ø 75.2 ㎜	wear limit : 0.2 ㎜
Play in bush			0.3 ㎜		
Thrust play			0 ~ 0.2 ㎜	0.5 ㎜	Adjust with adjusting bolt
DIFFERENTIAL	Pinion gear		0.05 ~0.06 ㎏f·m		
	Starting torque		6~7 ㎏f-cm		
Thrust play			0.1 ~ 0.3 ㎜		shim:0.1, 0.2 ㎜
Drive pinion/ring gear backlash			0.1 ~ 0.2 ㎜		shim:0.1, 0.2 ㎜

Part names and inspection items	Nominal dimensions	Standard value for reassembly	Usable limits	Service instructions and remarks

5.REAR AXLE (CHAPTER 7)

1) DISK BRAKE

FRICTION PLATE THICKNESS (WEAR AND CARBONIZER)		4.7 ± 0.1 ㎜	4.2 ㎜	

2)SEPARATE PLATE

Thickness (wear and damage)		2.5 ± 0.09 ㎜	2.5 ㎜	

3) BRAKE ROD TURN BUCKLE

Pedal play at the top		30 ~40 ㎜		

6. POWER STEERING SYSTEM(CHAPTER 8)

1) GEAR PUMP

Capacity	6.5 ㏄/rev (15.3 ℓ/min)	Theoretical value/revolution N=2600 rpm, P=150 ㎏f/㎠ Oil temperature : 50 ± 5 ℃
Direction of revolution	CCW at 500 ~ 3500 rpm	

7.HYDRAULIC SYSTEM (CHAPTER 9)

1) PISTON AND CYLINDER

cylinder and bore		Ø 75 ㎜		0-ring : Ø65㎜

Part names and inspection items	Nominal dimensions	Standard value for reassembly	Usable limits	Service instructions and remarks

2) Dynamic lift

T303HST/T353HST		2000 ㎏f·㎠		

3) Cylinder case bush

Left side	55 ×60 ×50	Ø 55 ㎜	Ø 55.2 ㎜	Wear limit: 0.2 ㎜
Right side	60 ×65 ×50	Ø 60 ㎜	Ø 60.2 ㎜	Wear limit: 0.2 ㎜

4) Flow divider

Capacity of PTO clutch port	3.0±0.25 ℓ/min	Pressure:1 ㎏f/㎠
Setting pressure of PTO clutch port	15 ㎏f/㎠ over	Capacity:0.9 ℓ/min

5) Flow divider assembly

Solenoid	Rated voltage	DC 12 V			
	Rated current	1.2 A			
	Switch-over frequency limit	2 times / sec			
Clearance between change over valve and casing			0.025 ㎜		
Free length of change over valve spring		15.5 ㎜	15.0 ㎜		
Clearance between sequential valve spool and casing			0.021 ㎜		
Free length of pressure reducing valve spring		30.0 ㎜	29.0 ㎜		

Sequence valve spring free length.		22.0 ㎜	21.5 ㎜	

Part names and inspection items	Nominal dimensions	Standard value for reassembly	Usable limits	Service instructions and remarks

6) SLOW RETURN CHECK VALVE(Flow control valve)

Maximum pressure	280 ㎏f/㎠	Gear oil SAE #80 ~ #90 at a temperature of 50 ± 5℃
Cylinder port leaks	1 ㏄/min.at a pressure of 90 ㎏f/㎠	

7) MAIN CONTROL VALVE

Cylinder port leaks	5 ㏄/min or less under a pressure of 100 ㎏f/㎠			Gear oil SAE #80 ~ #90 at a temperature of 50 ± 5℃
Clearance between main spool and casing			0.01 ㎜	

8) MAIN RELIEF VALVE

T303HST/T353HST		160+5 ㎏f/㎠		

9) MAIN GEAR PUMP

T303HST/T353HST		21.5 ℓ/min		Efficiency of 92 % at 2600 rpm

10) SUCTION FILTER

Rated flow		35 ℓ/min		
Filtration density		150 mesh		
Filtration area		450㎠		

11) LINE FILTER

Rated flow		35 ℓ/min		
Filtration density		80 mesh		

8.ELECTRICAL EQUIPMENT

1)BATTERY

(1)BATTERY TERMINAL POST

Terminal voltage	-	12 V	10.8 V	Charge or replace
Corrosion	-	-	-	Repair or replace

(2) BATTERY CELLS

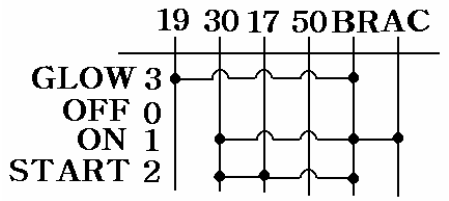
Damage	-	-	-	Replace battery

(3) ELECTROLITE

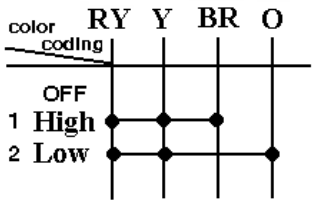
Cloudy fluid	-	-	-	Replace battery
Specific gravity	-	1.24 - 1.26	-	Correct
Level	-	As specified on case	-	Replace with distilled water.

2) METER PANEL AND OTHER SWITCHES.

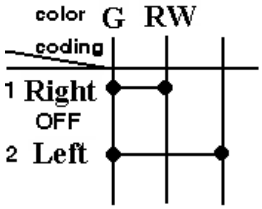
(1) STARTER SWITCH.

Continuity Across Each Terminal		Replace a defective switch assembly.

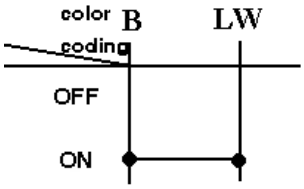
2) COMBINATION SWITCH (Light switch)

Continuity Across Each Terminal		Replace a defective switch assembly.

(3) Turn signal switch

●Turn signal switch		Replace a defective switch assembly.

(4) Horn switch

●Horn switch		Replace a defective switch assembly.

(6) PTO SWITCH

Continuity across each terminal	Switched on when lever is moved by about 3 mm (0.12 in) across R and LR	Replace a defective switch assembly.

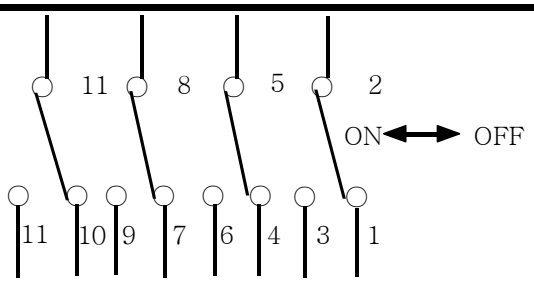
(7) STOP LIGHT SWITCH

Continuity across each terminal	Switched on when actuator is pushed in by about 3 mm(0.12 in)assembly	Replace a defective switch assembly.

(8) PARKING BRAKE SWITCH

Continuity across each terminal	Switched on when lever is pulled up by about 3 mm(0.12 in)	Replace a defective switch assembly.

(9) HAZARD WARNING SWITCH

Continuity across each terminal		Replace a defective switch assembly.

SECTION 2.TIGHTENING AND STARTING TORQUE SPECIFIED FOR MAJOR PARTS

1. T303HST/T353HST

TIGHTENING PARTS	BOLT AND NUT (HARDNESS)	TIGHTENING TORQUE (kgf·m)
1)Front axle housing (4WD type)		
①Axle bracket ~ Engine tightening bolts	M 16 (7T)	16.0 ~ 18.0
②Front pivot metal(support)tightening bolts	M 12 (7T)	9.0 ~ 11.0
③Rear pivot metal(support) tightening bolts	M 14 (7T)	13.0 ~ 15.0
④Front axle~final case tightening bolts.	M 12 (7T)	9.0 ~ 11.0
⑤Bearing cover tightening bolts.	M 18 (7T)	2.0 ~ 2.4
⑥Wheel shaft cover tightening bolts.	M 110 (7T)	5.5 ~ 7.0
⑦Front wheel tightening bolts.	M 16 (7T)	16.0 ~ 18.0
⑧Bevel gear case tightening bolts	M 8	1.3 ~ 1.8
⑨Dif-metal(support) tightening bolts	M 8	1.3 ~ 1.8
⑩Ring gear~dif metal(support)tightening bolts	M 8	1.3 ~ 1.8
Bevel pinion lock nut		
2)Transmission		
①Front transmission~Engine tightening bolts and nuts	M 12 (7T)	9.0 ~ 11.0
②Front transmission Spacer transmission tightening bolts and nuts	M 12 (7T)	9.0 ~ 11.0
③Space transmission~Rear transmission tightening bolts and nuts	M 12 (7T)	9.0 ~ 11.0
④Input metal(support)tightening bolts and nuts.		
⑤Drive pinion metal(support) tightening bolts.	M 12 (7T)	9.0 ~ 11.0
Drive pinion tightening nut	M 10 (7T)	5.5 ~ 7.0
⑥Dif-case metal(support)tightening bolts.		
⑦Dif case~ring gear tightening nuts.	M 12	5.5 ~ 7.0
	M 12 (7T)	9.0 ~ 11.0

SECTION 3. CONVERSION TABLES

Millimeters to inches

mm	in	mm	in	mm	in	mm	in
1	0.0394	26	1.0236	51	2.0079	76	2.9921
2	0.0787	27	1.0630	52	2.0472	77	3.0315
3	0.1181	28	1.1024	53	2.0866	78	3.0709
4	0.1575	29	1.1417	54	2.1260	79	3.1102
5	0.1969	30	1.1811	55	2.1654	80	3.1496
6	0.2362	31	1.2205	56	2.2047	81	3.1890
7	0.2756	32	1.2598	57	2.2441	82	3.2283
8	0.3150	33	1.2992	58	2.2835	83	3.2677
9	0.3543	34	1.3386	59	2.3228	84	3.3071
10	0.3937	35	1.3780	60	2.3622	85	3.3465
11	0.4331	36	1.4173	61	2.4016	86	3.3858
12	0.4724	37	1.4567	62	2.4409	87	3.4252
13	0.5118	38	1.4961	63	2.4803	88	3.4646
14	0.5512	39	1.5354	64	2.5197	89	3.5039
15	0.5906	40	1.5748	65	2.5591	90	3.5433
16	0.6299	41	1.6142	66	2.5984	91	3.5827
17	0.6693	42	1.6535	67	2.6378	92	3.6220
18	0.7087	43	1.6929	68	2.6772	93	3.6614
19	0.7480	44	1.7323	69	2.7165	94	3.7008
20	0.7874	45	1.7717	70	2.7559	95	3.7402
21	0.8268	46	1.8110	71	2.7953	96	3.7795
22	0.8661	47	1.8504	72	2.8346	97	3.8189
23	0.9055	48	1.8898	73	2.8740	98	3.8583
24	0.9449	49	1.9291	74	2.9134	99	3.8976
25	0.9843	50	1.9685	75	2.9528	100	3.9370

Inches to millimeters

in	mm	in	mm	in	mm
1/64	0.3969	25/64	9.9219	13/16	20.6375
1/32	0.7938	13/32	10.3188	53/64	21.0344
3/64	1.1906	27/64	10.7156	27/32	21.4313
1/16	1.5875	7/16	11.1125	55/64	21.8281
5/64	1.9844	29/64	11.5094	7/8	22.2250
3/32	2.3813	15/32	11.9063	57/64	22.6219
7/64	2.7781	31/64	12.3031	29/32	23.0188
1/8	3.1750	1/2	12.7000	59/64	23.4156
9/64	3.5719	33/64	13.0969	15/16	23.8125
5/32	3.9688	17/32	13.4938	61/64	24.2094
11/64	4.3656	35/64	13.8906	31/32	24.6063
3/16	4.7625	9/16	14.2875	63/64	25.0031
13/64	5.1594	37/64	14.6844		
7/32	5.5563	19/32	15.0813		
15/64	5.9531	39/64	15.4781		
1/4	6.3500	5/8	15.8750		
17/64	6.7469	41/64	16.2719		
9/32	7.1438	21/32	16.6688		
19/64	7.5406	43/64	17.0656		
5/16	7.9375	11/16	17.4625		
21/64	8.3344	45/64	17.8594		
11/32	8.7313	23/32	18.2563		
23/64	9.1281	47/64	18.6531		
3/8	9.5250	3/4	19.0500		
		49/64	19.4469		
		25/32	19.8438		
		51/64	20.2406		

	Length					Feet to Meters					
ft	0	1	2	3	4	5	6	7	8	9	ft
	m	m	m	m	m	m	m	m	m	m	
0	0.0000	0.3050	0.6100	0.9150	1.2200	1.5250	1.8300	2.1350	2.4400	2.7450	0
10	8.0532	3.3550	3.6600	3.9650	4.2700	4.5750	4.8800	5.1850	5.4900	5.7950	10
20	21.1097	6.4050	6.7100	7.0150	7.3200	7.6250	7.9300	8.2350	8.5400	8.8450	20
30	34.1661	9.4550	9.7600	10.0650	10.3700	10.6750	10.9800	11.2850	11.5900	11.8950	30
40	47.2225	12.5050	12.8100	13.1150	13.4200	13.7250	14.0300	14.3350	14.6400	14.9450	40
50	60.2790	15.5550	15.8600	16.1650	16.4700	16.7750	17.0800	17.3850	17.6900	17.9950	50
60	73.3354	18.6050	18.9100	19.2150	19.5200	19.8250	20.1300	20.4350	20.7400	21.0450	60
70	86.3919	21.6550	21.9600	22.2650	22.5700	22.8750	23.1800	23.4850	23.7900	24.0950	70
80	99.4483	24.7050	25.0100	25.3150	25.6200	25.9250	26.2300	26.5350	26.8400	27.1450	80
90	112.5047	27.7550	28.0600	28.3650	28.6700	28.9750	29.2800	29.5850	29.8900	30.1950	90
100	125.5612	30.8050	31.1100	31.4150	31.7200	32.0250	32.3300	32.6350	32.9400	33.2450	100

						Meters to Feet					
m	0	1	2	3	4	5	6	7	8	9	m
	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	
0	0.0000	3.2808	6.5616	9.8424	13.1232	16.4040	19.6848	22.9656	26.2464	29.5272	0
10	32.8080	36.0888	39.3696	42.6504	45.9312	49.2120	52.4928	55.7736	59.0544	62.3352	10
20	65.6160	68.8968	72.1776	75.4584	78.7392	82.0200	85.3008	88.5816	91.8624	95.1432	20
30	98.4240	101.7048	104.9856	108.2664	111.5472	114.8280	118.1088	121.3896	124.6704	127.9512	30
40	131.2320	134.5128	137.7936	141.0744	144.3552	147.6360	150.9168	154.1976	157.4784	160.7592	40
50	164.0400	167.3208	170.6016	173.8824	177.1632	180.4440	183.7248	187.0056	190.2864	193.5672	50
60	196.8480	200.1288	203.4096	206.6904	209.9712	213.2520	216.5328	219.8136	223.0944	226.3752	60
70	229.6560	232.9368	236.2176	239.4984	242.7792	246.0600	249.3408	252.6216	255.9024	259.1832	70
80	262.4640	265.7448	269.0256	272.3064	275.5872	278.8680	282.1488	285.4296	288.7104	291.9912	80
90	295.2720	298.5528	301.8336	305.1144	308.3952	311.6760	314.9568	318.2376	321.5184	324.7992	90
100	328.0800	331.3608	334.6416	337.9224	341.2032	344.4840	347.7648	351.0456	354.3264	357.6072	100

						Mile to kilometers					
miles	0	1	2	3	4	5	6	7	8	9	miles
	Km	Km	Km	Km	Km	Km	Km	Km	Km	Km	
0	0.000	1.609	3.218	4.827	6.436	8.045	9.654	11.263	12.872	14.481	0
10	16.090	17.699	19.308	20.917	22.526	24.135	25.744	27.353	28.962	30.571	10
20	32.180	33.789	35.398	37.007	38.616	40.225	41.834	43.443	45.052	46.661	20
30	48.270	49.879	51.488	53.097	54.706	56.315	57.924	59.533	61.142	62.751	30
40	64.360	65.969	67.578	69.187	70.796	72.405	74.014	75.623	77.232	78.841	40
50	80.450	82.059	83.668	85.277	86.886	88.495	90.104	91.713	93.322	94.931	50
60	96.540	98.149	99.758	101.367	102.976	104.585	106.194	107.803	109.412	111.021	60
70	112.630	114.239	115.848	117.457	119.066	120.675	122.284	123.893	125.502	127.111	70
80	128.720	130.329	131.938	133.547	135.156	136.765	138.374	139.983	141.592	143.201	80
90	144.810	146.419	148.028	149.637	151.246	152.855	154.464	156.073	157.682	159.291	90
100	160.900	162.509	164.118	165.727	167.336	168.945	170.554	172.163	173.772	175.381	100

						kilometers to Miles					
Km	0	1	2	3	4	5	6	7	8	9	Km
	Miles	Miles	Miles	Miles	Miles	Miles	Miles	Miles	Miles	Miles	
0	0.000	0.621	1.242	1.863	2.484	3.105	3.726	4.347	4.968	5.589	0
10	6.210	6.831	7.452	8.073	8.694	9.315	9.936	10.557	11.178	11.799	10
20	12.420	13.041	13.662	14.283	14.904	15.525	16.146	16.767	17.388	18.009	20
30	18.630	19.251	19.872	20.493	21.114	21.735	22.356	22.977	23.598	24.219	30
40	24.840	25.461	26.082	26.703	27.324	27.945	28.566	29.187	29.808	30.429	40
50	31.050	31.671	32.292	32.913	33.534	34.155	34.776	35.397	36.018	36.639	50
60	37.260	37.881	38.502	39.123	39.744	40.365	40.986	41.607	42.228	42.849	60
70	43.470	44.091	44.712	45.333	45.954	46.575	47.196	47.817	48.438	49.059	70
80	49.680	50.301	50.922	51.543	52.164	52.785	53.406	54.027	54.648	55.269	80
90	55.890	56.511	57.132	57.753	58.374	58.995	59.616	60.237	60.858	61.479	90
100	62.100	62.721	63.342	63.963	64.584	65.205	65.826	66.447	67.068	67.689	100

	Area				Square inches to square centimeters						
in2	0	1	2	3	4	5	6	7	8	9	in2
	cm2	cm2	cm2	cm2	cm2	cm2	cm2	cm2	cm2	cm2	
0	0.000	6.462	12.924	19.386	25.848	32.310	38.772	45.234	51.696	58.158	0
10	64.620	71.082	77.544	84.006	90.468	96.930	103.392	109.854	116.316	122.778	10
20	129.240	135.702	142.164	148.626	155.088	161.550	168.012	174.474	180.936	187.398	20
30	193.860	200.322	206.784	213.246	219.708	226.170	232.632	239.094	245.556	252.018	30
40	258.480	264.942	271.404	277.866	284.328	290.790	297.252	303.714	310.176	316.638	40
50	323.100	329.562	336.024	342.486	348.948	355.410	361.872	368.334	374.796	381.258	50
60	387.720	394.182	400.644	407.106	413.568	420.030	426.492	432.954	439.416	445.878	60
70	452.340	458.802	465.264	471.726	478.188	484.650	491.112	497.574	504.036	510.498	70
80	516.960	523.422	529.884	536.346	542.808	549.270	555.732	562.194	568.656	575.118	80
90	581.580	588.042	594.504	600.966	607.428	613.890	620.352	626.814	633.276	639.738	90
100	646.200	652.662	659.124	665.586	672.048	678.510	684.972	691.434	697.896	704.358	100

	Square centimeters to Square inches										
cm2	0	1	2	3	4	5	6	7	8	9	cm2
	in2	in2	in2	in2	in2	in2	in2	in2	in2	in2	
0	0.000	0.155	0.310	0.465	0.620	0.775	0.930	1.085	1.240	1.395	0
10	1.550	1.705	1.860	2.015	2.170	2.325	2.480	2.635	2.790	2.945	10
20	3.100	3.255	3.410	3.565	3.720	3.875	4.030	4.185	4.340	4.495	20
30	4.650	4.805	4.960	5.115	5.270	5.425	5.580	5.735	5.890	6.045	30
40	6.200	6.355	6.510	6.665	6.820	6.975	7.130	7.285	7.440	7.595	40
50	7.750	7.905	8.060	8.215	8.370	8.525	8.680	8.835	8.990	9.145	50
60	9.300	9.455	9.610	9.765	9.920	10.075	10.230	10.385	10.540	10.695	60
70	10.850	11.005	11.160	11.315	11.470	11.625	11.780	11.935	12.090	12.245	70
80	12.400	12.555	12.710	12.865	13.020	13.175	13.330	13.485	13.640	13.795	80
90	13.950	14.105	14.260	14.415	14.570	14.725	14.880	15.035	15.190	15.345	90
100	15.500	15.655	15.810	15.965	16.120	16.275	16.430	16.585	16.740	16.895	100

	Cubic inches to Cubic Centimeters										
in3	0	1	2	3	4	5	6	7	8	9	in3
	cm3(cc)	cm3(cc)	cm3(cc)	cm3(cc)	cm3(cc)	cm3(cc)	cm3(cc)	cm3(cc)	cm3(cc)	cm3(cc)	
0	0.000	16.387	32.774	49.161	65.548	81.935	98.322	114.709	131.096	147.483	0
10	163.870	180.257	196.644	213.031	229.418	245.805	262.192	278.579	294.966	311.353	10
20	327.740	344.127	360.514	376.901	393.288	409.675	426.062	442.449	458.836	475.223	20
30	491.610	507.997	524.384	540.771	557.158	573.545	589.932	606.319	622.706	639.093	30
40	655.480	671.867	688.254	704.641	721.028	737.415	753.802	770.189	786.576	802.963	40
50	819.350	835.737	852.124	868.511	884.898	901.285	917.672	934.059	950.446	966.833	50
60	983.220	999.607	1015.994	1032.381	1048.768	1065.155	1081.542	1097.929	1114.316	1130.703	60
70	1147.090	1163.477	1179.864	1196.251	1212.638	1229.025	1245.412	1261.799	1278.186	1294.573	70
80	1310.960	1327.347	1343.734	1360.121	1376.508	1392.895	1409.282	1425.669	1442.056	1458.443	80
90	1474.830	1491.217	1507.604	1523.991	1540.378	1556.765	1573.152	1589.539	1605.926	1622.313	90
100	1638.700	1655.087	1671.474	1687.861	1704.248	1720.635	1737.022	1753.409	1769.796	1786.183	100

	Cubic Centimeters to cubic inches										
cm3(cc)	0	1	2	3	4	5	6	7	8	9	cm3(cc)
	in3	in3	in3	in3	in3	in3	in3	in3	in3	in3	
0	0.0000	0.0610	0.1221	0.1831	0.2441	0.3051	0.3662	0.4272	0.4882	0.5492	0
10	0.6103	0.6713	0.7323	0.7933	0.8544	0.9154	0.9764	1.0374	1.0985	1.1595	10
20	1.2205	1.2815	1.3426	1.4036	1.4646	1.5256	1.5867	1.6477	1.7087	1.7697	20
30	1.8308	1.8918	1.9528	2.0138	2.0749	2.1359	2.1969	2.2579	2.3190	2.3800	30
40	2.4410	2.5020	2.5631	2.6241	2.6851	2.7461	2.8072	2.8682	2.9292	2.9902	40
50	3.0513	3.1123	3.1733	3.2343	3.2954	3.3564	3.4174	3.4784	3.5395	3.6005	50
60	3.6615	3.7225	3.7836	3.8446	3.9056	3.9666	4.0277	4.0887	4.1497	4.2107	60
70	4.2718	4.3328	4.3938	4.4548	4.5159	4.5769	4.6379	4.6989	4.7600	4.8210	70
80	4.8820	4.9430	5.0041	5.0651	5.1261	5.1871	5.2482	5.3092	5.3702	5.4312	80
90	5.4923	5.5533	5.6143	5.6753	5.7364	5.7974	5.8584	5.9194	5.9805	6.0415	90
100	6.1025	6.1635	6.2246	6.2856	6.3466	6.4076	6.4687	6.5297	6.5907	6.6517	100

	Volume				Gallons(U.S) to Liters						
US gal	0	1	2	3	4	5	6	7	8	9	US gal
	Liters	Liters	Liters	Liters	Liters	Liters	Liters	Liters	Liters	Liters	
0	0.000	3.785	7.571	11.356	15.142	18.927	22.712	26.498	30.283	34.069	0
10	37.854	41.639	45.425	49.210	52.996	56.781	60.566	64.352	68.137	71.923	10
20	75.708	79.493	83.279	87.064	90.850	94.635	98.420	102.206	105.991	109.777	20
30	113.562	117.347	121.133	124.918	128.704	132.489	136.274	140.060	143.845	147.631	30
40	151.416	155.201	158.987	162.772	166.558	170.343	174.128	177.914	181.699	185.485	40
50	189.270	193.055	196.841	200.626	204.412	208.197	211.982	215.768	219.553	223.339	50
60	227.124	230.909	234.695	238.480	242.266	246.051	249.836	253.622	257.407	261.193	60
70	264.978	268.763	272.549	276.334	280.120	283.905	287.690	291.476	295.261	299.047	70
80	302.832	306.617	310.403	314.188	317.974	321.759	325.544	329.330	333.115	336.901	80
90	340.686	344.471	348.257	352.042	355.828	359.613	363.398	367.184	370.969	374.755	90
100	378.540	382.325	386.111	389.896	393.682	397.467	401.252	405.038	408.823	412.609	100

	Liters to Gallons(U.S)										
Liters	0	1	2	3	4	5	6	7	8	9	Liters
	US gal	US gal	US gal	US gal	US gal	US gal	US gal	US gal	US gal	US gal	
0	0.000	0.264	0.528	0.793	1.057	1.321	1.585	1.849	2.114	2.378	0
10	2.642	2.906	3.170	3.435	3.699	3.963	4.227	4.491	4.756	5.020	10
20	5.284	5.548	5.812	6.077	6.341	6.605	6.869	7.133	7.398	7.662	20
30	7.926	8.190	8.454	8.719	8.983	9.247	9.511	9.775	10.040	10.304	30
40	10.568	10.832	11.096	11.361	11.625	11.889	12.153	12.417	12.682	12.946	40
50	13.210	13.474	13.738	14.003	14.267	14.531	14.795	15.059	15.324	15.588	50
60	15.852	16.116	16.380	16.645	16.909	17.173	17.437	17.701	17.966	18.230	60
70	18.494	18.758	19.022	19.287	19.551	19.815	20.079	20.343	20.608	20.872	70
80	21.136	21.400	21.664	21.929	22.193	22.457	22.721	22.985	23.250	23.514	80
90	23.778	24.042	24.306	24.571	24.835	25.099	25.363	25.627	25.892	26.156	90
100	26.420	26.684	26.948	27.213	27.477	27.741	28.005	28.269	28.534	28.798	100

	Gallons(IMP.) to Liters										
Imp. ga	0	1	2	3	4	5	6	7	8	9	Imp. gal
	Liters	Liters	Liters	Liters	Liters	Liters	Liters	Liters	Liters	Liters	
0	0.0000	4.5460	9.0920	13.6380	18.1840	22.7300	27.2760	31.8220	36.3680	40.9140	0
10	45.4600	50.0060	54.5520	59.0980	63.6440	68.1900	72.7360	77.2820	81.8280	86.3740	10
20	90.9200	95.4660	100.0120	104.5580	109.1040	113.6500	118.1960	122.7420	127.2880	131.8340	20
30	136.3800	140.9260	145.4720	150.0180	154.5640	159.1100	163.6560	168.2020	172.7480	177.2940	30
40	181.8400	186.3860	190.9320	195.4780	200.0240	204.5700	209.1160	213.6620	218.2080	222.7540	40
50	227.3000	231.8460	236.3920	240.9380	245.4840	250.0300	254.5760	259.1220	263.6680	268.2140	50
60	272.7600	277.3060	281.8520	286.3980	290.9440	295.4900	300.0360	304.5820	309.1280	313.6740	60
70	318.2200	322.7660	327.3120	331.8580	336.4040	340.9500	345.4960	350.0420	354.5880	359.1340	70
80	363.6800	368.2260	372.7720	377.3180	381.8640	386.4100	390.9560	395.5020	400.0480	404.5940	80
90	409.1400	413.6860	418.2320	422.7780	427.3240	431.8700	436.4160	440.9620	445.5080	450.0540	90
100	454.6000	459.1460	463.6920	468.2380	472.7840	477.3300	481.8760	486.4220	490.9680	495.5140	100

	Liters to Gallons(IMP)										
Liters	0	1	2	3	4	5	6	7	8	9	Liters
	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	
0	0.0000	0.2200	0.4400	0.6600	0.8800	1.1000	1.3200	1.5400	1.7600	1.9800	0
10	2.2000	2.4200	2.6400	2.8600	3.0800	3.3000	3.5200	3.7400	3.9600	4.1800	10
20	4.4000	4.6200	4.8400	5.0600	5.2800	5.5000	5.7200	5.9400	6.1600	6.3800	20
30	6.6000	6.8200	7.0400	7.2600	7.4800	7.7000	7.9200	8.1400	8.3600	8.5800	30
40	8.8000	9.0200	9.2400	9.4600	9.6800	9.9000	10.1200	10.3400	10.5600	10.7800	40
50	11.0000	11.2200	11.4400	11.6600	11.8800	12.1000	12.3200	12.5400	12.7600	12.9800	50
60	13.2000	13.4200	13.6400	13.8600	14.0800	14.3000	14.5200	14.7400	14.9600	15.1800	60
70	15.4000	15.6200	15.8400	16.0600	16.2800	16.5000	16.7200	16.9400	17.1600	17.3800	70
80	17.6000	17.8200	18.0400	18.2600	18.4800	18.7000	18.9200	19.1400	19.3600	19.5800	80
90	19.8000	20.0200	20.2400	20.4600	20.6800	20.9000	21.1200	21.3400	21.5600	21.7800	90
100	22.0000	22.2200	22.4400	22.6600	22.8800	23.1000	23.3200	23.5400	23.7600	23.9800	100

	MASS					Pounds to Kilograms					
lbs	0	1	2	3	4	5	6	7	8	9	lbs
	Kg	Kg	Kg	Kg	Kg	Kg	Kg	Kg	Kg	Kg	
0	0.000	0.454	0.907	1.361	1.814	2.268	2.722	3.175	3.629	4.082	0
10	4.536	4.990	5.443	5.897	6.350	6.804	7.258	7.711	8.165	8.618	10
20	9.072	9.526	9.979	10.433	10.886	11.340	11.794	12.247	12.701	13.154	20
30	13.608	14.062	14.515	14.969	15.422	15.876	16.330	16.783	17.237	17.690	30
40	18.144	18.598	19.051	19.505	19.958	20.412	20.866	21.319	21.773	22.226	40
50	22.680	23.134	23.587	24.041	24.494	24.948	25.402	25.855	26.309	26.762	50
60	27.216	27.670	28.123	28.577	29.030	29.484	29.938	30.391	30.845	31.298	60
70	31.752	32.206	32.659	33.113	33.566	34.020	34.474	34.927	35.381	35.834	70
80	36.288	36.742	37.195	37.649	38.102	38.556	39.010	39.463	39.917	40.370	80
90	40.824	41.278	41.731	42.185	42.638	43.092	43.546	43.999	44.453	44.906	90
100	45.360	45.814	46.267	46.721	47.174	47.628	48.082	48.535	48.989	49.442	100

						Kilograms to pound					
Kg	0	1	2	3	4	5	6	7	8	9	Kg
	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs	
0	0.000	2.205	4.409	6.614	8.818	11.023	13.228	15.432	17.637	19.841	0
10	22.046	24.251	26.455	28.660	30.864	33.069	35.274	37.478	39.683	41.887	10
20	44.092	46.297	48.501	50.706	52.910	55.115	57.320	59.524	61.729	63.933	20
30	66.138	68.343	70.547	72.752	74.956	77.161	79.366	81.570	83.775	85.979	30
40	88.184	90.389	92.593	94.798	97.002	99.207	101.412	103.616	105.821	108.025	40
50	110.230	112.435	114.639	116.844	119.048	121.253	123.458	125.662	127.867	130.071	50
60	132.276	134.481	136.685	138.890	141.094	143.299	145.504	147.708	149.913	152.117	60
70	154.322	156.527	158.731	160.936	163.140	165.345	167.550	169.754	171.959	174.163	70
80	176.368	178.573	180.777	182.982	185.186	187.391	189.596	191.800	194.005	196.209	80
90	198.414	200.619	202.823	205.028	207.232	209.437	211.642	213.846	216.051	218.255	90
100	220.460	222.665	224.869	227.074	229.278	231.483	233.688	235.892	238.097	240.301	100

						Kilograms to Newton					
Kg	0	1	2	3	4	5	6	7	8	9	Kg
	N	N	N	N	N	N	N	N	N	N	
0	0.000	9.807	19.614	29.421	39.228	49.035	58.842	68.649	78.456	88.263	0
10	98.070	107.877	117.684	127.491	137.298	147.105	156.912	166.719	176.526	186.333	10
20	196.140	205.947	215.754	225.561	235.368	245.175	254.982	264.789	274.596	284.403	20
30	294.210	304.017	313.824	323.631	333.438	343.245	353.052	362.859	372.666	382.473	30
40	392.280	402.087	411.894	421.701	431.508	441.315	451.122	460.929	470.736	480.543	40
50	490.350	500.157	509.964	519.771	529.578	539.385	549.192	558.999	568.806	578.613	50
60	588.420	598.227	608.034	617.841	627.648	637.455	647.262	657.069	666.876	676.683	60
70	686.490	696.297	706.104	715.911	725.718	735.525	745.332	755.139	764.946	774.753	70
80	784.560	794.367	804.174	813.981	823.788	833.595	843.402	853.209	863.016	872.823	80
90	882.630	892.437	902.244	912.051	921.858	931.665	941.472	951.279	961.086	970.893	90
100	980.700	990.507	1000.314	1010.121	1019.928	1029.735	1039.542	1049.349	1059.156	1068.963	100

						Newton to Kilograms					
N	0	1	2	3	4	5	6	7	8	9	N
	Kg	Kg	Kg	Kg	Kg	Kg	Kg	Kg	Kg	Kg	
0	0.000	1.020	2.039	3.059	4.079	5.099	6.118	7.138	8.158	9.177	0
10	10.197	11.217	12.236	13.256	14.276	15.296	16.315	17.335	18.355	19.374	10
20	20.394	21.414	22.433	23.453	24.473	25.493	26.512	27.532	28.552	29.571	20
30	30.591	31.611	32.630	33.650	34.670	35.690	36.709	37.729	38.749	39.768	30
40	40.788	41.808	42.827	43.847	44.867	45.887	46.906	47.926	48.946	49.965	40
50	50.985	52.005	53.024	54.044	55.064	56.084	57.103	58.123	59.143	60.162	50
60	61.182	62.202	63.221	64.241	65.261	66.281	67.300	68.320	69.340	70.359	60
70	71.379	72.399	73.418	74.438	75.458	76.478	77.497	78.517	79.537	80.556	70
80	81.576	82.596	83.615	84.635	85.655	86.675	87.694	88.714	89.734	90.753	80
90	91.773	92.793	93.812	94.832	95.852	96.872	97.891	98.911	99.931	100.950	90
100	101.970	102.990	104.009	105.029	106.049	107.069	108.088	109.108	110.128	111.147	100

	Pressure	Pounds per square inches to Kilograms per square centimeters									
b/in2(PSI	0	1	2	3	4	5	6	7	8	9	lb/in2(PSI)
	Kg/cm2	Kg/cm2	Kg/cm2	Kg/cm2	Kg/cm2	Kg/cm2	Kg/cm2	Kg/cm2	Kg/cm2	Kg/cm2	
0	0.0000	0.0703	0.1406	0.2109	0.2812	0.3516	0.4219	0.4922	0.5625	0.6328	0
10	0.7031	0.7734	0.8437	0.9140	0.9843	1.0547	1.1250	1.1953	1.2656	1.3359	10
20	1.4062	1.4765	1.5468	1.6171	1.6874	1.7578	1.8281	1.8984	1.9687	2.0390	20
30	2.1093	2.1796	2.2499	2.3202	2.3905	2.4609	2.5312	2.6015	2.6718	2.7421	30
40	2.8124	2.8827	2.9530	3.0233	3.0936	3.1640	3.2343	3.3046	3.3749	3.4452	40
50	3.5155	3.5858	3.6561	3.7264	3.7967	3.8671	3.9374	4.0077	4.0780	4.1483	50
60	4.2186	4.2889	4.3592	4.4295	4.4998	4.5702	4.6405	4.7108	4.7811	4.8514	60
70	4.9217	4.9920	5.0623	5.1326	5.2029	5.2733	5.3436	5.4139	5.4842	5.5545	70
80	5.6248	5.6951	5.7654	5.8357	5.9060	5.9764	6.0467	6.1170	6.1873	6.2576	80
90	6.3279	6.3982	6.4685	6.5388	6.6091	6.6795	6.7498	6.8201	6.8904	6.9607	90
100	7.0310	7.1013	7.1716	7.2419	7.3122	7.3826	7.4529	7.5232	7.5935	7.6638	100

	Kilograms per square centimeters to Pounds per square inches										
Kg/cm2	0	1	2	3	4	5	6	7	8	9	Kg/cm2
	lb/in2(psi)	lb/in2(psi)	lb/in2(psi)	lb/in2(psi)	lb/in2(psi)	lb/in2(psi)	lb/in2(psi)	lb/in2(psi)	lb/in2(psi)	lb/in2(psi)	
0	0.00	14.22	28.45	42.67	56.89	71.12	85.34	99.56	113.78	128.01	0
10	142.23	156.45	170.68	184.90	199.12	213.35	227.57	241.79	256.01	270.24	10
20	284.46	298.68	312.91	327.13	341.35	355.58	369.80	384.02	398.24	412.47	20
30	426.69	440.91	455.14	469.36	483.58	497.81	512.03	526.25	540.47	554.70	30
40	568.92	583.14	597.37	611.59	625.81	640.04	654.26	668.48	682.70	696.93	40
50	711.15	725.37	739.60	753.82	768.04	782.27	796.49	810.71	824.93	839.16	50
60	853.38	867.60	881.83	896.05	910.27	924.50	938.72	952.94	967.16	981.39	60
70	995.61	1009.83	1024.06	1038.28	1052.50	1066.73	1080.95	1095.17	1109.39	1123.62	70
80	1137.84	1152.06	1166.29	1180.51	1194.73	1208.96	1223.18	1237.40	1251.62	1265.85	80
90	1280.07	1294.29	1308.52	1322.74	1336.96	1351.19	1365.41	1379.63	1393.85	1408.08	90
100	1422.30	1436.52	1450.75	1464.97	1479.19	1493.42	1507.64	1521.86	1536.08	1550.31	100

	Kilograms per square centimeters to Kilo pascal										
Kg/cm2	0	1	2	3	4	5	6	7	8	9	Kg/cm2
	Kpa	Kpa	Kpa	Kpa	Kpa	Kpa	Kpa	Kpa	Kpa	Kpa	
0	0.0	98.1	196.1	294.2	392.3	490.4	588.4	686.5	784.6	882.6	0
10	980.7	1078.8	1176.8	1274.9	1373.0	1471.1	1569.1	1667.2	1765.3	1863.3	10
20	1961.4	2059.5	2157.5	2255.6	2353.7	2451.8	2549.8	2647.9	2746.0	2844.0	20
30	2942.1	3040.2	3138.2	3236.3	3334.4	3432.5	3530.5	3628.6	3726.7	3824.7	30
40	3922.8	4020.9	4118.9	4217.0	4315.1	4413.2	4511.2	4609.3	4707.4	4805.4	40
50	4903.5	5001.6	5099.6	5197.7	5295.8	5393.9	5491.9	5590.0	5688.1	5786.1	50
60	5884.2	5982.3	6080.3	6178.4	6276.5	6374.6	6472.6	6570.7	6668.8	6766.8	60
70	6864.9	6963.0	7061.0	7159.1	7257.2	7355.3	7453.3	7551.4	7649.5	7747.5	70
80	7845.6	7943.7	8041.7	8139.8	8237.9	8336.0	8434.0	8532.1	8630.2	8728.2	80
90	8826.3	8924.4	9022.4	9120.5	9218.6	9316.7	9414.7	9512.8	9610.9	9708.9	90
100	9807.0	9905.1	10003.1	10101.2	10199.3	10297.4	10395.4	10493.5	10591.6	10689.6	100

	Kilo pascal to kilogram per square centimeters										
Kpa	0	100	200	300	400	500	600	700	800	900	Kpa
	Kg/cm2	Kg/cm2	Kg/cm2	Kg/cm2	Kg/cm2	Kg/cm2	Kg/cm2	Kg/cm2	Kg/cm2	Kg/cm2	
0	0.000	1.020	2.039	3.059	4.079	5.099	6.118	7.138	8.158	9.177	0
1000	10.197	11.217	12.236	13.256	14.276	15.296	16.315	17.335	18.355	19.374	1000
2000	20.394	21.414	22.433	23.453	24.473	25.493	26.512	27.532	28.552	29.571	2000
3000	30.591	31.611	32.630	33.650	34.670	35.690	36.709	37.729	38.749	39.768	3000
4000	40.788	41.808	42.827	43.847	44.867	45.887	46.906	47.926	48.946	49.965	4000
5000	50.985	52.005	53.024	54.044	55.064	56.084	57.103	58.123	59.143	60.162	5000
6000	61.182	62.202	63.221	64.241	65.261	66.281	67.300	68.320	69.340	70.359	6000
7000	71.379	72.399	73.418	74.438	75.458	76.478	77.497	78.517	79.537	80.556	7000
8000	81.576	82.596	83.615	84.635	85.655	86.675	87.694	88.714	89.734	90.753	8000
9000	91.773	92.793	93.812	94.832	95.852	96.872	97.891	98.911	99.931	100.950	9000
10000	101.970	102.990	104.009	105.029	106.049	107.069	108.088	109.108	110.128	111.147	10000

	Torque	Foot pounds to Kilogram meters									
	0	1	2	3	4	5	6	7	8	9	ft lbs
	Kg-m	Kg-m	Kg-m	Kg-m	Kg-m	Kg-m	Kg-m	Kg-m	Kg-m	Kg-m	
		0.138	0.276	0.414	0.552	0.690	0.828	0.966	1.104	1.242	
10	1.380	1.518	1.656	1.794	1.932	2.070	2.208	2.346	2.484	2.622	10
20	2.760	2.898	3.036	3.174	3.312	3.450	3.588	3.726	3.864	4.002	20
30	4.140	4.278	4.416	4.554	4.692	4.830	4.968	5.106	5.244	5.382	30
40	5.520	5.658	5.796	5.934	6.072	6.210	6.348	6.486	6.624	6.762	40
50	6.900	7.038	7.176	7.314	7.452	7.590	7.728	7.866	8.004	8.142	50
60	8.280	8.418	8.556	8.694	8.832	8.970	9.108	9.246	9.384	9.522	60
70	9.660	9.798	9.936	10.074	10.212	10.350	10.488	10.626	10.764	10.902	70
80	11.040	11.178	11.316	11.454	11.592	11.730	11.868	12.006	12.144	12.282	80
90	12.420	12.558	12.696	12.834	12.972	13.110	13.248	13.386	13.524	13.662	90
100	13.800	13.938	14.076	14.214	14.352	14.490	14.628	14.766	14.904	15.042	100

	Kilogram meters to Foot pounds										
	0	1	2	3	4	5	6	7	8	9	Kg-m
	ft-lbs	ft-lbs	ft-lbs	ft-lbs	ft-lbs	ft-lbs	ft-lbs	ft-lbs	ft-lbs	ft-lbs	
		7.230	14.470	21.690	28.930	36.170	43.400	50.630	57.870	65.100	
10	72.300	79.530	86.770	93.990	101.230	108.470	115.700	122.930	130.170	137.400	10
20	144.600	151.830	159.070	166.290	173.530	180.770	188.000	195.230	202.470	209.700	20
30	216.900	224.130	231.370	238.590	245.830	253.070	260.300	267.530	274.770	282.000	30
40	289.200	296.430	303.670	310.890	318.130	325.370	332.600	339.830	347.070	354.300	40
50	361.500	368.730	375.970	383.190	390.430	397.670	404.900	412.130	419.370	426.600	50
60	433.800	441.030	448.270	455.490	462.730	469.970	477.200	484.430	491.670	498.900	60
70	506.100	513.330	520.570	527.790	535.030	542.270	549.500	556.730	563.970	571.200	70
80	578.400	585.630	592.870	600.090	607.330	614.570	621.800	629.030	636.270	643.500	80
90	650.700	657.930	665.170	672.390	679.630	686.870	694.100	701.330	708.570	715.800	90
100	723.000	730.230	737.470	744.690	751.930	759.170	766.400	773.630	780.870	788.100	100

	Kilogram meters to newtonmeters										
	0	1	2	3	4	5	6	7	8	9	Kg-m
	N-m	N-m	N-m	N-m	N-m	N-m	N-m	N-m	N-m	N-m	
		9.810	19.610	29.420	39.230	49.030	58.810	68.650	78.450	88.260	
10	98.100	107.910	117.710	127.520	137.330	147.130	156.910	166.750	176.550	186.360	10
20	196.200	206.010	215.810	225.620	235.430	245.230	255.010	264.850	274.650	284.460	20
30	294.300	304.110	313.910	323.720	333.530	343.330	353.110	362.950	372.750	382.560	30
40	392.400	402.210	412.010	421.820	431.630	441.430	451.210	461.050	470.850	480.660	40
50	490.500	500.310	510.110	519.920	529.730	539.530	549.310	559.150	568.950	578.760	50
60	588.600	598.410	608.210	618.020	627.830	637.630	647.410	657.250	667.050	676.860	60
70	686.700	696.510	706.310	716.120	725.930	735.730	745.510	755.350	765.150	774.960	70
80	784.800	794.610	804.410	814.220	824.030	833.830	843.610	853.450	863.250	873.060	80
90	882.900	892.710	902.510	912.320	922.130	931.930	941.710	951.550	961.350	971.160	90
100	981.000	990.810	1000.610	1010.420	1020.230	1030.030	1039.810	1049.650	1059.450	1069.260	100

	Newtonmeters to Kilogrammeters										
	0	10	20	30	40	50	60	70	80	90	N-m
	Kg-m	Kg-m	Kg-m	Kg-m	Kg-m	Kg-m	Kg-m	Kg-m	Kg-m	Kg-m	
0	0.000	1.020	2.040	3.060	4.080	5.100	6.120	7.140	8.160	9.180	0
100	10.200	11.220	12.240	13.260	14.280	15.300	16.320	17.340	18.360	19.380	100
200	20.400	21.420	22.440	23.460	24.480	25.500	26.520	27.540	28.560	29.580	200
300	30.600	31.620	32.640	33.660	34.680	35.700	36.720	37.740	38.760	39.780	300
400	40.800	41.820	42.840	43.860	44.880	45.900	46.920	47.940	48.960	49.980	400
500	51.000	52.020	53.040	54.060	55.080	56.100	57.120	58.140	59.160	60.180	500
600	61.200	62.220	63.240	64.260	65.280	66.300	67.320	68.340	69.360	70.380	600
700	71.400	72.420	73.440	74.460	75.480	76.500	77.520	78.540	79.560	80.580	700
800	81.600	82.620	83.640	84.660	85.680	86.700	87.720	88.740	89.760	90.780	800
900	91.800	92.820	93.840	94.860	95.880	96.900	97.920	98.940	99.960	100.980	900
1000	102.000	103.020	104.040	105.060	106.080	107.100	108.120	109.140	110.160	111.180	1000

Temperature	Fahrenheit to Centigrade		
˚F	˚C	˚F	˚C
−20	−28.9	95	35.0
−15	−26.1	100	37.8
−10	−23.3	105	40.6
−5	−20.6	110	43.3
0	−17.8	115	46.1
1	−17.2	120	48.9
2	−16.7	125	51.7
3	−16.1	130	54.4
4	−15.6	135	57.2
5	−15.0	140	60.0
10	−12.2	145	62.8
15	−9.4	150	65.6
20	−6.7	155	68.3
25	−3.9	160	71.1
30	−1.1	165	73.9
35	1.7	170	76.7
40	4.4	175	79.4
45	7.2	180	82.2
50	10.0	185	85.0
55	12.8	190	87.8
60	15.6	195	90.6
65	18.3	200	93.3
70	21.1	205	96.1
75	23.9	210	98.9
80	26.7	212	100.0
85	29.4		
90	32.2		

Centigrade to Fahrenheit			
˚C	˚F	˚C	˚F
−30	−22.0	36	96.8
−28	−18.4	38	100.4
−26	−14.8	40	104.0
−24	−11.2	42	107.6
−22	−7.6	44	111.2
−20	−4.0	46	114.8
−18	−0.4	48	118.4
−16	3.2	50	122.0
−14	6.8	52	125.6
−12	10.4	54	129.2
−10	14.0	56	132.8
−8	17.6	58	136.4
−6	21.2	60	140.0
−4	24.8	62	143.6
−2	28.4	64	147.2
0	32.0	66	150.8
2	35.6	68	154.4
4	39.2	70	158.0
6	42.8	72	161.6
8	46.4	74	165.2
10	50.0	76	168.8
12	53.6	78	172.4
14	57.2	80	176.0
16	60.8	82	179.6
18	64.4	84	183.2
20	68.0	86	186.8
22	71.6	88	190.4
24	75.2	90	194.0
26	78.8	92	197.6
28	82.4	94	201.2
30	86.0	96	204.8
32	89.6	98	208.4
34	93.2	100	212.0

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